REMARKS

Claims 1 and 49-72 are pending in this application.

Applicants respectfully request reconsideration and withdrawal of the rejections in view of the arguments set forth below.

Improper Final Office Action

The Examiner rejected Claim 1 under 35 U.S.C. § 112, first paragraph, as allegedly being non-enabling. This is a new rejection that has never before been raised, and it is not necessitated by Applicants' claim amendment, not prompted by Applicants' submission of an information disclosure statement (IDS) under 37 C.F.R. § 1.97(c) with the fee set forth in 37 C.F.R. § 1.17(p), and not prompted by Applicants' submission of the requirements for the joint research agreement prior art exclusion under 35 U.S.C. § 103(c). Therefore, the Office Action cannot be properly made Final under MPEP 706.07(a).

Nevertheless, Applicants file this RCE response to address the substantive issues below.

Rejection under 35 U.S.C. § 112, first paragraph (enablement)

The Examiner raised a new ground of rejection to Claim 1, alleging that Claim 1 is non-enabled because "the specification provides no details as to what Applicant considers such [sic] flexible materials."

Applicants respectfully disagree.

First of all, Applicants submit that it was well known at the time of the invention that certain materials suitable for making microneedle, such as those described on page 7, second paragraph, can be made flexible (although they can also be made non-flexible depending on manufacture conditions). For example, as argued before and herein below, certain plastic materials may be made flexible to produce products such as credit card, or plastic wraps for food products, but may also be made literally indestructible (as school desk top, tubing, for example), and certainly would not "allow the device to fit the contour of the biological barrier."

Pursuant to MPEP 2164.01, "[a] patent need not teach, and preferably omits, what is well known in the art. *In re Buchner*, 929 F.2d 660, 661, 18 USPQ2d 1331, 1332 (Fed. Cir. 1991); *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 1384, 231 USPQ 81, 94

(Fed. Cir. 1986), *cert. denied*, 480 U.S. 947 (1987); and *Lindemann Maschinenfabrik GMBH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 1463, 221 USPQ 481, 489 (Fed. Cir. 1984)." Therefore, Applicants assert that the specification is enabled for using flexible materials to make the substrate and/or the microneedles.

Secondly, the Office Action cited prior art patent Gerstel as an anticipatory reference. If Gerstel has taught, as the Examiner alleges, how to make flexible substrate / microneedles, then the Examiner is implicitly asserting that the prior art has taught how to make flexible substrate / microneedles. Thus under *In re Buchner* (*supra*), there is no ground for the Examiner to maintain the enablement rejection based on the argument that the specification does not explicitly teach, and the art does not know how to make flexible substrate / microneedles.

Conversely, to anticipate the claims, the prior art reference (such as Gerstel) must be enabling. *See* MPEP 2121.01: " '[i]n determining that quantum of prior art disclosure which is necessary to declare an applicant's invention 'not novel' or 'anticipated' within section 102, the stated test is whether a reference contains an 'enabling disclosure' ... .' *In re Hoeksema*, 399 F.2d 269, 158 USPQ 596 (CCPA 1968). The disclosure in an assertedly anticipating reference must provide an enabling disclosure of the desired subject matter; mere naming or description of the subject matter is insufficient, if it cannot be produced without undue experimentation. *Elan Pharm., Inc. v. Mayo Found. For Med. Educ. & Research*, 346 F.3d 1051, 1054, 68 USPQ2d 1373, 1376 (Fed. Cir. 2003)." (emphasis added)

If the Examiner maintains the enablement rejection, the prior art rejection based on Gerstel should be withdrawn, because in making the enablement rejection, the Examiner is arguing that, as of the filing date of the instant application, the art (including Gerstel) does not know how to use flexible material to make substrate / microneedles. Thus Gerstel is non-enabling, and cannot be relied upon for the anticipatory rejection.

Applicants will also provide below further, independent arguments to traverse the anticipatory rejection based on Gerstel.

For the reasons above, Applicants respectfully request reconsideration and withdrawal of the enablement rejection.

Rejection under 35 U.S.C. § 102(b)

The Office Action maintains the rejection of Claims 1 and 49-70 under 35 U.S.C. § 102(b) in view of Gerstel *et al.* (U.S. Pat. No. 3,964,482, or "Gerstel"). The Office Action alleges that columns 10-11 of Gerstel teach that the substrate (**14**) and/or the microneedle are formed from flexible materials. Specifically, in response to Applicants' request to clarify the rejection, the Office Action points to column 10, line 55 to column 11, line 2, and argues that "... the projections being made out of polymers such as polyethylene, PTFE, etc, which are well known to be flexible and thus would inherently be capable of allowing the device to fit the contour of a barrier."

Applicants respectively disagree.

Applicants submit that both polyethylene and PTFE (TEFLON®) can be made flexible or non-flexible, depending on specific needs. For example, Gower *et al.* (*Neurosurgery* **31(6)**: 1132-1135, 1992, **Exhibit A**) discloses on page 1132, middle column, last paragraph that "PTFE is a tough nonflexible material that can be modified by an expansion process to make the plastic flexible. This expansion can be regulated to accurately provide varying porosities from 5 to 120 μm, depending on the requirements of the application." Similarly, Jeong (U.S. 2004/0244858 A1, **Exhibit B**) discloses a spiral hose comprising a hard member (**10**, see Figures 1 and 2) made from high-density polyethylene (HDPE) to "maintain its original shape even when a strong suction pressure is formed inside the spiral hose" (paragraph **[0097]**), and a soft member (**20**, see Figures 1 and 2) made from polyethylene tarpaulin to provide flexibility (paragraph **[0097]**).

Thus in both references, PTFE and polyethylene are shown to be capable of either being tough and nonflexible or flexible, depending on specific needs.

Contrary to the evidence Applicants provided herein, the Examiner has cited no reference to support the assertion that "polyethylene, PTFE, etc ... are well known to be flexible." If the Examiner is relying on personal or common knowledge, Applicants respectfully request the examiner to provide an affidavit or declaration setting forth specific factual statements and explanation to support the finding. *See* 37 C.F.R. § 1.104(d)(2). Applicants also respectfully remind the Examiner that "[i]f applicant adequately traverses the examiner's assertion of official notice, the examiner must provide documentary evidence in the next Office action if the rejection is to be maintained. *See* 37 C.F.R. § 1.104(c)(2). *See* also

Zurko, 258 F.3d at 1386, 59 USPQ2d at 1697 ("[t]he Board [or examiner] must point to some concrete evidence in the record in support of these findings" to satisfy the substantial evidence test)." MPEP 2144.03, Section C.

Applicants have also presented the following arguments in the previously filed Office Action responses, but the Examiner has not responded to any of these specific arguments advanced by the Applicants. Applicants hereby summarize these previously made arguments below, and respectfully request the Examiner to either withdraw the anticipatory rejection in view of these arguments, or to provide a reason why such arguments are not persuasive to overcome the rejection based on Gerstel.

(1) Gerstel explicitly *teaches away* from the feature of flexibility

Gerstel not only fails to explicitly teach or suggest that the materials suitable for making the substrate and/or the microneedles are flexible, but also *teaches away* from using flexible materials.

Specifically, as Gerstel describes in the paragraph bridging paragraphs 11 and 12, the <u>key quality</u> that makes a material a good candidate for drug release rate control is "its structure, its degree of saturation, the presence of cross-linking, the solubility of the drug in the material, the thickness of the material..." There is no mentioning anywhere of <u>flexibility</u> being a relevant factor.

In fact, Gerstel explicitly *teaches away* from the feature of flexibility in col. 8, lines 30-42, by characterizing the suitable materials for base **24** as having "high degree of impact strength," "good hardness," "<u>resistance to deformation</u>," "good tensile strength," *etc.*, such as "metals and alloys," "steels," *etc.*:

> "The puncturing projections **12** and base **24**, as described above, can be made from <u>a wide variety of materials</u>. One class of suitable materials is polymers and the polymeric derivatives thereof. The polymers acceptable for forming puncturing projections of solid design (which carry drug along their exterior surface) or projections made with a passageway and openings at both ends are <u>materials characterized by properties such as a high degree of impact strength, good hardness, resistance to deformation, good tensile strength,</u> does not adversely effect the drug or the host, and readily lend themselves to forming puncturing projections for penetrating or piercing the stratum corneum.
> ...
> Puncturing projections **12** and base **24** of this design can also be made from other materials such as <u>metals and alloys</u>. Examples of metals and alloys include <u>stainless steel; tungsten steel; manganese steel; tantalum; titanium alloys</u>

> consisting of nickel, molybdenum and chromium; vitallium alloys consisting of cobalt, chromium and molybdenum; and the like." (emphasis added)

(2) The Gerstel device itself is nonflexible even if the "drug release rate controlling material" happens to be flexible

Even if *some parts* of the Gerstel devices (see Figures 1-6 of Gerstel) may be made of a drug release rate controlling material that happens to be flexible, it does not necessarily mean that the device itself is flexible so as to "allow the device to fit the contour of the biological barrier," as recited in the claims. For example, in Figure 5 of Gerstel, membrane **34** is formed of a drug release rate controlling material, while base membrane **24** and puncturing projections **12** can be formed "from a single piece of stainless steel..." It is difficult to imaging that the device in Figure 5 can fit the contour of the biological barrier given its steel construction at the bottom.

(3) The broad genus of "thermoplastic materials" cannot anticipate a species of "flexible material"

The Office Action rejects the claimed invention on the basis that the broadly disclosed genus of "drug release rate controlling material" allegedly anticipates the species of "flexible material." Applicants respectfully disagree for the same reason in record.

To reiterate, there is no doubt that a species will anticipate a claim to a genus. *In re Slayter*, 276 F.2d 408, 411 (CCPA 1960); *In re Gosteli*, 872 F.2d 1008 (Fed. Cir. 1989). Also *see* MPEP 2131.02. However, the reverse is generally not true, *i.e.*, a broadly disclosed genus generally does not anticipate a species within the genus, unless: (1) such a species is "clearly named," or (2) "when the species can be 'at once envisaged' from the (genus) formula." MPEP 2131.02.

As argued above, Gerstel does not "clearly name" the recited "flexible material." The Office Action fails to specifically point out where in Gerstel (especially in col. 10-11) such "flexible material" is disclosed. Neither can Applicants identify such a disclosure in Gerstel.

Applicants also submit that a skilled artisan cannot "at once envisage" the recited flexible material from the broad Gerstel disclosure of "drug release rate controlling materials." Applicants wish to draw the Examiner's attention to the controlling case law *Akzo N.V. v. International Trade Comm'n*, 808 F.2d 1471 (Fed. Cir. 1986).

In *Akzo*, claims to a process for making aramid fibers using a 98% solution of sulfuric acid were found not anticipated by a cited reference, which disclosed using sulfuric acid solution, but which did not disclose using a 98% concentrated sulfuric acid solution. The Federal Circuit, after reviewing the International Trade Commission (ITC) investigation record, held that the factual findings of the Administrative Law Judge (ALJ) presiding over the investigation were supported by substantial evidence. Thus the court affirmed the ALJ conclusion that "sulfuric acid in any concentration was not disclosed as a solvent in the reference." *Akzo*, 808 F.2d at 1480. The court also found that the ALJ properly relied on *In re Arkley*, 455 F.2d 586, 587 (CCPA 1972) to reject "random picking and choosing" of prior art, and affirmed the ALJ conclusion that "the anticipatory reference must disclose in the prior art a thing substantially identical with the claimed invention. In a somewhat more limited consideration - restricted to the concentration of sulfuric acid in the Blades patent" (emphasis added). *Akzo*, 808 F.2d at 1480.

If "sulfuric acid solution" does not anticipate the claimed "98% concentrated sulfuric acid solution," Applicants submit that "drug release controlling materials" cannot anticipate "flexible (drug release controlling) materials." Gerstel explicitly teaches that the base **24** "can be made from a wide variety of materials," including such non-flexible and "resisting to deformation" materials as metal, alloy, and steel. Therefore, a skilled artisan could not imagine, let alone "at once envisage" from this broad genus any specific species, especially those species materials that are flexible.

For all the reasons of record and reiterated above, Applicants submit that Gerstel cannot anticipate the claimed invention. Reconsideration and withdrawal of the rejection under 35 U.S.C. § 102(b) are respectfully requested.

Claim Rejections under 35 U.S.C. § 103(a)

Claim 72 is rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Gerstel as modified by Eicher *et al.*, or by Godshall *et al.*

As discussed above, Applicants reiterate that the pending claims recite features neither disclosed nor suggested by Gerstel. Neither Eicher nor Godshall teach or suggest the subject matter recited in the amended independent Claim 70, from which Claim 72 depends. Thus Claim 72 is patentable for the same reasons that Claims 1 and 70 are patentable.

Therefore, Applicants respectfully request reconsideration and withdrawal of the rejections under 35 U.S.C. § 103(a).

CONCLUSION

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

We believe that we have appropriately provided for fees due in connection with this submission. However, if there are any other fees due in connection with the filing of this Response, please charge the fees to our Deposit Account No. **18-1945**, from which the undersigned is authorized to draw under the Order No. **BVTP-P04-506**.

Dated: October 4, 2007

Respectfully submitted,

By______________________

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INSTRUMENTATION AND APPLICATION

e-PTFE Ventricular Shunt Catheters

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THE PERFECT POLYMER surface for implantation should resist the adhesion of bacteria while producing no reaction in surrounding tissues. Silicone elastomer is a common material used for medical implantation devices. This material is superior to most available for implantation because of its flexibility and low, but detectable, tissue reaction. We have evaluated a flexible, expanded polytetrafluoroethylene (e-PTFE) ventricular catheter for cerebrospinal fluid shunting and have found that although e-PTFE is safe for cerebral implantation, the porosity of the material allows tissue ingrowth that obstructs the lumen. Our limited clinical evaluation of 5-µm internodal distance e-PTFE revealed that this open-cell structure, allowing tissue ingrowth, apparently is a poor candidate to replace silicone elastomer in cerebrospinal fluid shunting devices. However, further investigation may provide a polymer superior to silicone elastomer to create a cerebrospinal fluid shunt. (Neurosurgery 31:1132–1135, 1992)

Key words: Cerebrospinal fluid shunt, e-PTFE, Hydrocephalus, Internodal distance

Silicone elastomers are the primary materials for all cerebrospinal fluid (CBF) shunting devices on the market today. With the advantage of being relatively inexpensive as well as flexible, silicone elastomers can be easily formed into a variety of shapes and sizes and can be made radiopaque.

Although the silicone elastomers are good, they are not perfect materials for implantation. First, they do not repel bacterial attachments. Despite meticulous surgical technique, silicone elastomer implants become infected. Second, the presence of silicone elastomer in the CSF is associated with CSF eosinophilia in up to 34% of patients (8, 9). This would suggest a host reaction to the prosthetic device. Eosinophilia is associated with a significantly greater system failure and revision rate (9). In a study of sterile shunts that malfunctioned, a significantly larger population of cells were found to migrate on the internal surface of the silicone prosthesis when compared with shunt tubing removed for other reasons. Many of these cells appeared to be activated macrophage, prompting speculation that the presence of a silicone prosthetic device induced a delayed hypersensitivity reaction in some people (3). Finally, in most people, the presence of a long-term subcutaneous silicone shunt will induce a dense fibrous tract, supporting the statement of Traynelis et al. (8) "medical grade silicone rubber is not completely innocuous."

We have chosen to evaluate expanded polytetrafluoroethylene (e-PTFE) as a possible replacement for silicone elastomer in creating a CSF shunt. This material is presently being used for long-term implantation, with minimal adverse tissue reaction and a degree of bacterial adhesion that is different from that of silicone elastomers. PTFE is a tough nonflexible material that can be modified by an expansion process to make the plastic flexible. This expansion can be regulated to accurately provide varying porosities from 5 to 120 µm, depending on the requirements of the application. In e-PTFE, this porosity is termed *internodal distance* (IND). We have studied implantation in the laboratory as well as in a clinical setting and report our findings here.

MATERIALS AND METHODS

e-PTFE and silicone elastomer shunt tubing with an IND of 30 µm was obtained in individual 5-cm sections. The tubing was sterilized using standard gas sterilization procedures. The unimplanted tubing was processed for scanning electron microscopy (SEM) by fixation with 4% glutaraldehyde and critical point drying. The specimens were sputter coated and examined using a Hiatachi scanning electron microscope (Hiatachi Co., Japan) at various magnifications. During the examination, representative photomicrographs of the tubing were taken.

Two adult male rats were anesthetized using a mixture of ketamine/xylozine. The skin of the abdomen was shaved and prepared using povidone-iodine (Betadine, The Purdue Frederick Co., Norwalk, CT) and alcohol. A 1-cm midline incision was made, and three 1-cm long pieces of silicone tubing and three 1-cm pieces of 30 µm IND e-PTFE tubing were placed into the peritoneal cavity. The wound was closed with sutures. The animals were allowed to live for 1 month and then were killed with an overdose of anesthesia. The peritoneal catheters were harvested and placed in glutaraldehyde fixative and examined using SEM. After the results of the laboratory studies were evaluated, the clinical applicability of the 30-µm IND e-PTFE tubing was evaluated. Because our goal was to decrease the amount of tissue ingrowth in our clinical trial, we decided to use e-PTFE with reduced IND (5 µm, the shortest IND tubing available).

Two patients presented with subarachnoid hemorrhage and acute hydrocephalus, requiring ventricular drainage. In each of these patients, a 5-µm IND e-PTFE ventricular catheter (manufactured as a custom device by PS Medical, Goleta, CA) was placed into the ventricular system after patient consent was obtained. In the first patient, the ventricular catheter functioned normally and was removed 7 days after insertion. In the sec-

ond patient, the catheter became obstructed 4 days after placement. This e-PTFE catheter was removed and replaced with a standard silicone catheter. Both explanted e-PTFE catheters were fixed with glutaraldehyde and examined with scanning electron microscopy.

RESULTS

There was a marked difference between the internal surfaces of the shunt tubing before laboratory implantation. The e-PTFE catheter had multiple areas that were smooth with fine striations of stretched PTFE between them (Fig. 1). After implantation into the peritoneum, both types of tubing were found to be loosely bound to the visceral surfaces of the organs by a fine layer of connective tissue. The degree of tissue reaction was identical between the two types of tubing. There was no evidence of inflammation around any of the tubing sites. Once the fine layer of connective tissue layer was opened, the tubing was easily removed from the organ without adherence.

Figure 2 demonstrates the difference in the interaction of cells with the surface of each of these tubes. The silicone tubing had a number of cells adherent to its surface. In areas where the tubing had perforated holes, there was obvious tissue ingrowth and fibrous bands traversing between opposing holes. On the other hand, the e-PTFE tubing had a distinctly different interaction with the cells of the peritoneum. In these tubes, cells were seen migrating deeply into the tubing, and bands of fibrous material were densely adherent to the surface. The phenomenon was similar to the ingrowth and cross-linking of fibrous bands observed between the holes of the silicone tubing but on a much smaller scale. The apparent external surface of the tubing seen grossly was in fact a layer of cellular processes that had covered the surface. These results were the basis for our decision to use a shortened IND e-PTFE (5 μm) catheter in our clinical studies in an attempt to decrease potential cell infiltration.

Figure 3 shows grossly what the two catheters used for temporary ventricular drainage looked like after removal. The e-PTFE tubing was "stained" with both red and brown material that appeared to be within the structure of the tubing. The silicone tubing was white and unstained. No obvious material was adherent to the surface of the silicone tubing.

The SEM of the clinical catheters (Fig. 4) demonstrated a marked difference between the silicone and e-PTFE tubing. The e-PTFE tubing was found to have a fibrin coating on its internal surface as

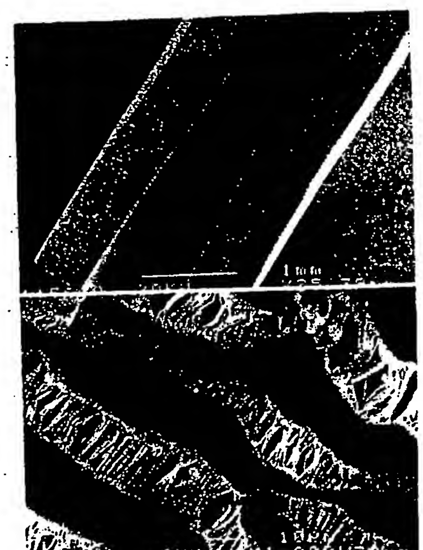

FIGURE 1. *A*, e-PTFE (IND 30 μm) tubing as seen with the scanning electron microscope at a magnification of ×25. *B*, high-power (×1000) view of e-PTFE tubing. Note the dense areas of PTFE separated by the strand-like areas that represent areas where the material was stretched. The tubing is semipermeable and flexible because of this expanded structure.

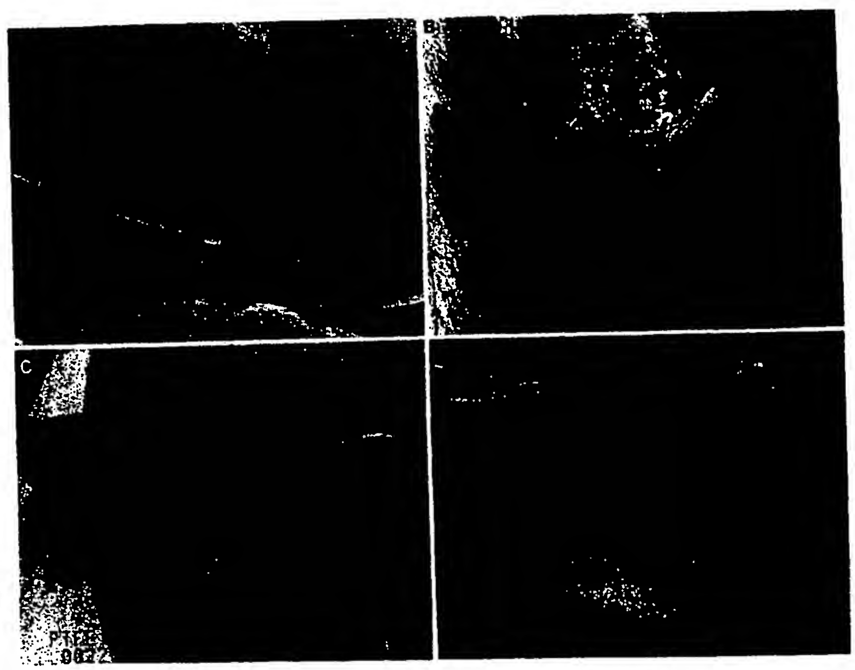

FIGURE 2. Both standard silicone plastic tubing and e-PTFE tubing were implanted into a rat peritoneum for 1 month. *A*, low-power view (×20) of the silicone tubing. *B*, higher-power view (×100) of the bridges of tissue between holes in the tubing. Note the apparent lack of adherence of the cells to the plastic. C, e-PTFE tubing seen at a magnification of ×30. *D*, e-PTFE (IND 30 μm) tubing seen at a magnification of ×20. Note the dense adherence of the tissues to the surface of the plastic, with apparent ingrowth into the interstices of the plastic.

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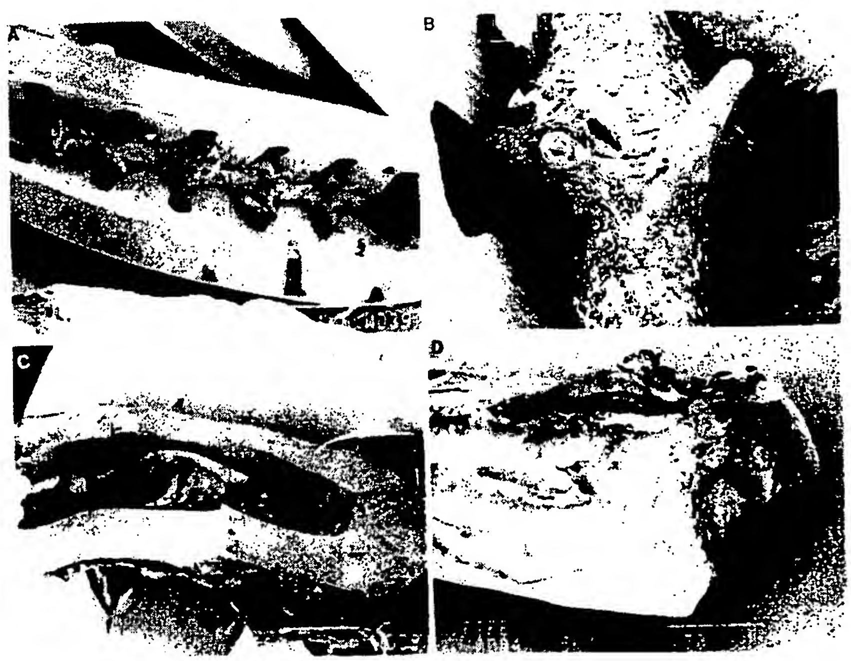

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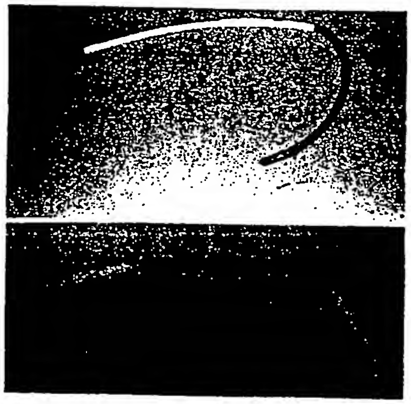

FIGURE 3. Two catheters were used as temporary ventricular drains. The catheters seen in *A* and *B* demonstrate "staining" of the e-PTFE portion of the catheter without staining of the silicone plastic. The staining appeared to be within the plastic and not on the surface and could not be wiped away.

well as a large population of cells. There was evidence that cell processes extended into the plastic internodes and facilitated adhesion to the internal surface in both of the patients. Because of the cellular ingrowth problems, even with a reduced IND of 5 μm, we discontinued the clinical series after only two patients.

DISCUSSION

Reducing the tissue reaction to implanted silicone as well as altering the surface to eliminate bacterial binding would greatly enhance the usefulness of silicone for implanted devices. Although these modifications in silicone are not readily available, perhaps the substitution of a polymer other than silicone would come closer to achieving these goals.

Teflon (PTFE) has been successfully used in intravenous catheters and has been noted to produce very little tissue reaction. Nelson and Garland (5) studied the rate of phlebitis occurring in 286 applications of Teflon intravenous catheter lines in a pediatric ward and concluded that this type of plastic is safe and efficacious, with a very low rate of phlebitis.

Adhesion of bacteria to a surface depends on the species of bacteria and the surface characteristics. Paschal et al. (6) studied the ability of various strains of *Staphylococcus epidermidis* to adhere to the surface of Teflon catheters, depending on the number of hydrophobic groups that the bacteria expressed in its surface coat. They found that a greater degree of bacterial hydrophobicity was associated with better bacterial adhesion. They also observed that removal of these hydrophobic groups from the bacteria by treatment with a protease produced a bacteria that adhered very poorly to artificial surfaces.

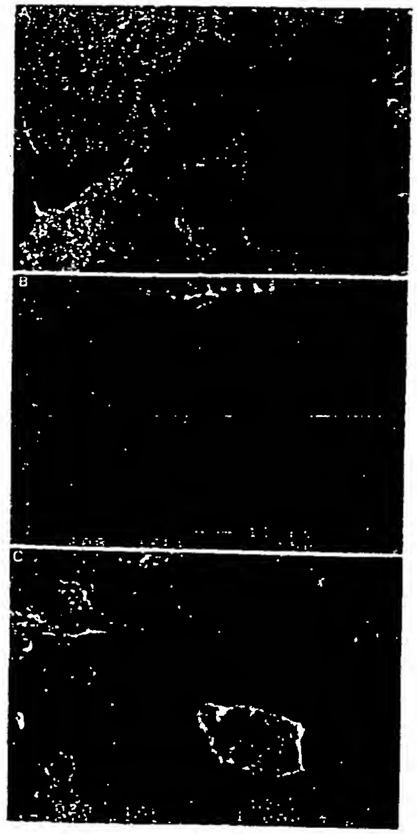

FIGURE 4. *A*, scanning electron micrograph of e-PTFE (IND 5 μm) tubing (×150) taken from catheters used as temporary drains. There is a dense sheet of cells that coats the internal surface of the tubing well away from the area where the holes allowing CSF into the system are present. *B*, SEM of e-PTFE (5 μm) tubing (×150) from the second implanted catheter. There is a fibrin-like protein coating the internal surface of the tubing. *C*, SEM (×1000) of the silicone plastic tubing taken in close proximity to the connector with the e-PTFE catheter. There are greatly reduced numbers of cells and protein debris on the internal surface.

Gower et al. (2) used a series of topical modifications to silicone elastomer to alter this degree of hydrophobicity. In this series of experiments, the surface was temporarily modified by soaking it in a variety of solutions, including antibiotics, proteins, and detergents. The greatest reduction in the number of adherent bacteria was found when the catheter material was modified by soaking it in an organic detergent like bacitracin-A. Very little effect was found in bacterial adhesion when the surface was modified by treatment with an antibiotic or with a protein solution alone. These experiments suggest that bacterial adhesion to plastic may be modified by altering the surface with a detergent or by removing hydrophobic groups from the coat of the native bacteria.

Three studies have compared various materials for their ability to repel bacterial attachment (1, 4, 7). In each of these studies, the Teflon surface was superior at repelling the adhesion of *S. epidermis* when compared with silicone elastomer or polyvinyl chloride.

The literature suggests that e-PTFE would be a superior material from which to construct a CSF shunt, based on e-PTFE's low level of tissue reaction and its ability to repel bacterial attachment. Teflon is most commonly seen in its tough nonflexible state. The process of expansion, however, gives the material flexibility that is very important in the fabrication of a shunt that is to be implanted.

Our preliminary trial using e-PTFE as a potential shunt material was undertaken after reviewing the literature and determining that e-PTFE was safe for plastic implant devices. Our initial laboratory study compared the e-PTFE to silicone elastomer in the rat peritoneum and found the tissue and leukocyte reaction to be similar to both materials.

Microscopic studies on these pieces of tubing suggested that the process of expansion makes the Teflon tubing porous and allows ingrowth of cells into the lumen of the catheter. It was our feeling after this laboratory study that this ingrowth may in fact be beneficial by allowing passage of macrophages as well as fibroblasts. These macrophages may pro-

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Teflon (PTFE) has been successfully used in intravenous catheters and has been noted to produce very little tissue reaction. Nelson and Garland (5) studied the rate of phlebitis occurring in 286 applications of Teflon intravenous catheter lines in a pediatric ward and concluded that this type of plastic is safe and efficacious, with a very low rate of phlebitis.

Adhesion of bacteria to a surface depends on the species of bacteria and the surface characteristics. Paschal et al. (6) studied the ability of various strains of *Staphylococcus epidermidis* to adhere to

FIGURE 4. *A*, scanning electron micrograph of e-PTFE (IND 5 µm) tubing (×150) taken from catheters used as temporary drains. There is a dense sheet of cells that coats the internal surface of the tubing well away from the area where the holes allowing CSF into the system are present. *B*, SEM of e-PTFE (5 µm) tubing (×150) from the second implanted catheter. There is a fibrin-like protein coating the internal surface of the tubing. *C*, SEM (×1000) of the silicone plastic tubing taken in close proximity to the connector with the e-PTFE catheter. There are greatly reduced numbers of cells and protein debris on the internal surface.

the surface of Teflon catheters, depending on the number of hydrophobic groups that the bacteria expressed in its surface coat. They found that a greater degree of bacterial hydrophobicity was associated with better bacterial adhesion. They also observed that removal of these hydrophobic groups from the bacteria by treatment with a protease produced a bacteria that adhered very poorly to artificial surfaces.

Gower et al. (2) used a series of topical modifications to silicone elastomer to alter this degree of hydrophobicity. In this series of experiments, the surface was temporarily modified by soaking it in a variety of solutions, including antibiotics, proteins, and detergents. The greatest reduction in the number of adherent bacteria was found when the catheter material was modified by soaking it in an organic detergent like bacitracin-A. Very little effect was found in bacterial adhesion when the surface was modified by treatment with an antibiotic or with a protein solution alone. These experiments suggest that bacterial adhesion to plastic may be modified by altering the surface with a detergent or by removing hydrophobic groups from the coat of the native bacteria.

Three studies have compared various materials for their ability to repel bacterial attachment (1, 4, 7). In each of these studies, the Teflon surface was superior at repelling the adhesion of *S. epidermis* when compared with silicone elastomer or polyvinyl chloride.

The literature suggests that e-PTFE would be a superior material from which to construct a CSF shunt, based on e-PTFE's low level of tissue reaction and its ability to repel bacterial attachment. Teflon is most commonly seen in its tough nonflexible state. The process of expansion, however, gives the material flexibility that is very important in the fabrication of a shunt that is to be implanted.

Our preliminary trial using e-PTFE as a potential shunt material was undertaken after reviewing the literature and determining that e-PTFE was safe for plastic implant devices. Our initial laboratory study compared the e-PTFE to silicone elastomer in the rat peritoneum and found the tissue and leukocyte reaction to be similar to both materials.

Microscopic studies on these pieces of tubing suggested that the process of expansion makes the Teflon tubing porous and allows ingrowth of cells into the lumen of the catheter. It was our feeling after this laboratory study that this ingrowth may in fact be beneficial by allowing passage of macrophages as well as fibroblasts. These macrophages may pro-

vide a greater immune surveillance of the external and, potentially, the internal surface of the shunt system.

The positive results from the laboratory studies led to a limited clinical trial of the expanded catheter in two patients. In both of our clinical cases, there was significant ingrowth of cells into the wall of the catheter. In one case, the ingrowth caused the obstruction of the catheter in 4 days. We conclude from these studies that e-PTFE has many of the characteristics necessary to make a superior shunt system, (i.e., bacterial resistance, flexibility, low tissue reaction), but the required porous nature of the tubing allows ingrowth of cells that may lead to occlusion of the tubing. For these reasons, we think that the expanded catheter with an IND of 5 μm or greater is not acceptable for long-term implantation.

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COMMENTS

The authors report the results of a study that they performed in laboratory animals (adult rats) and in two patients to evaluate the potential application of Teflon (e-PTFE) to the manufacture of shunts. They point out that there are several theoretical reasons why this material may be ideal for use in shunt manufacture. However, the results of the study show that the pore size in the material they used led to ingrowth of tissue into the catheter, which is more likely to lead to occlusion than the silastic tubing now used.

Long-term functioning of shunts without complication is the obvious goal of all neurosurgeons who perform shunting procedures. We see the problems caused by shunt obstruction and should constantly seek better answers. The authors must be encouraged in their effort even though it did not lead to a positive result. We must continue to search for better shunts, including the materials going into their manufacture.

Harold L. Rekate
Phoenix, Arizona

This is a study to investigate a new plastic polymer used to manufacture a ventricular catheter in the hopes that a catheter would be found that has the qualities of being nonreactive to the surrounding tissue and not allowing bacteria to adhere to its outer surface. It also would be worthwhile to have a catheter that prevents ingrowth of the surrounding tissue into the interstices of the catheter.

This catheter was first evaluated in a couple of laboratory animals and then, after appropriate consent, placed within the ventricular system of two humans after subarachnoid hemorrhage. The catheters were then extracted and examined with the scanning electron microscope. In all cases, it was shown that this catheter is quite porous, having a large number of microscopic openings that facilitated the ingrowth of tissue. Therefore, this catheter is not likely to be useful as part of a shunt system.

David G. McLone
Chicago, Illinois

Exhibit B

US 20040244858A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2004/0244858 A1

Jeong (43) Pub. Date: Dec. 9, 2004

(54) SPIRAL HOSE USING POLYETHYLENE

(76) Inventor: In-Seon Jeong, Seoul (KR)

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(21) Appl. No.: 10/484,553

(22) PCT Filed: Jul. 24, 2002

(86) PCT No.: PCT/KR02/01387

(30) Foreign Application Priority Data

Jul. 24, 2001 (KR) 2001-22364 U
Jan. 15, 2002 (KR) 2002-2357
Jan. 15, 2002 (KR) 2002-2358
Jan. 15, 2002 (KR) 2002-2359
Feb. 7, 2002 (KR) 2002-7141
Mar. 13, 2002 (KR) 2002-13572

Publication Classification

(51) Int. Cl.[7] F16L 11/00
(52) U.S. Cl. 138/122; 138/125; 138/129; 138/149; 138/134

(57) ABSTRACT

Disclosed is a spiral hose which includes a hard spiral member made from polyethylene and a thin soft spiral member made from polyethylene tarpaulin, and which can be used not only as a general hose but also as a gas duct or a watering hose. The spiral hose is wound in a spiral shape to have flexibility. The spiral hose comprises: a hard member made from polyethylene, which is wound in a spiral shape with a uniform spiral gap formed between turns of the hard member, and a soft member having a shape of a band and being formed of polyethylene tarpaulin, the soft member being disposed along the spiral gap while lateral edges of the soft member are fixed to portions of the hard member, which are disposed oppositely on both sides of the spiral gap.

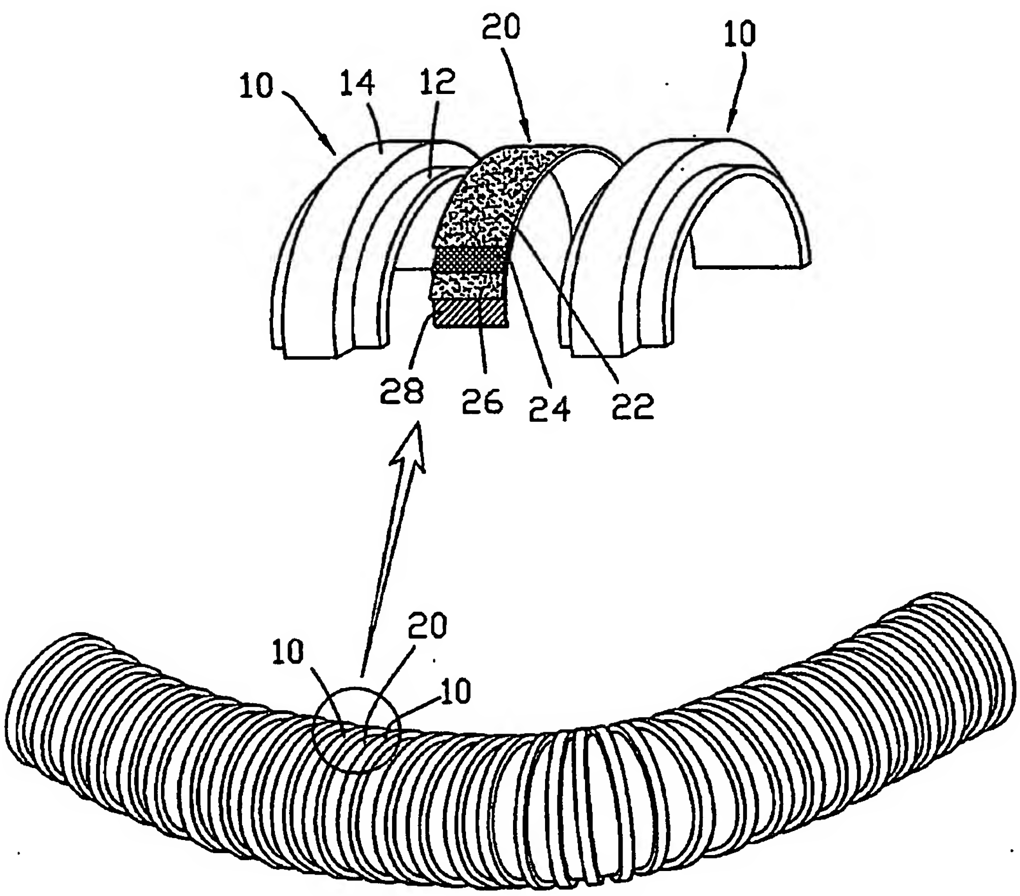


FIG 1

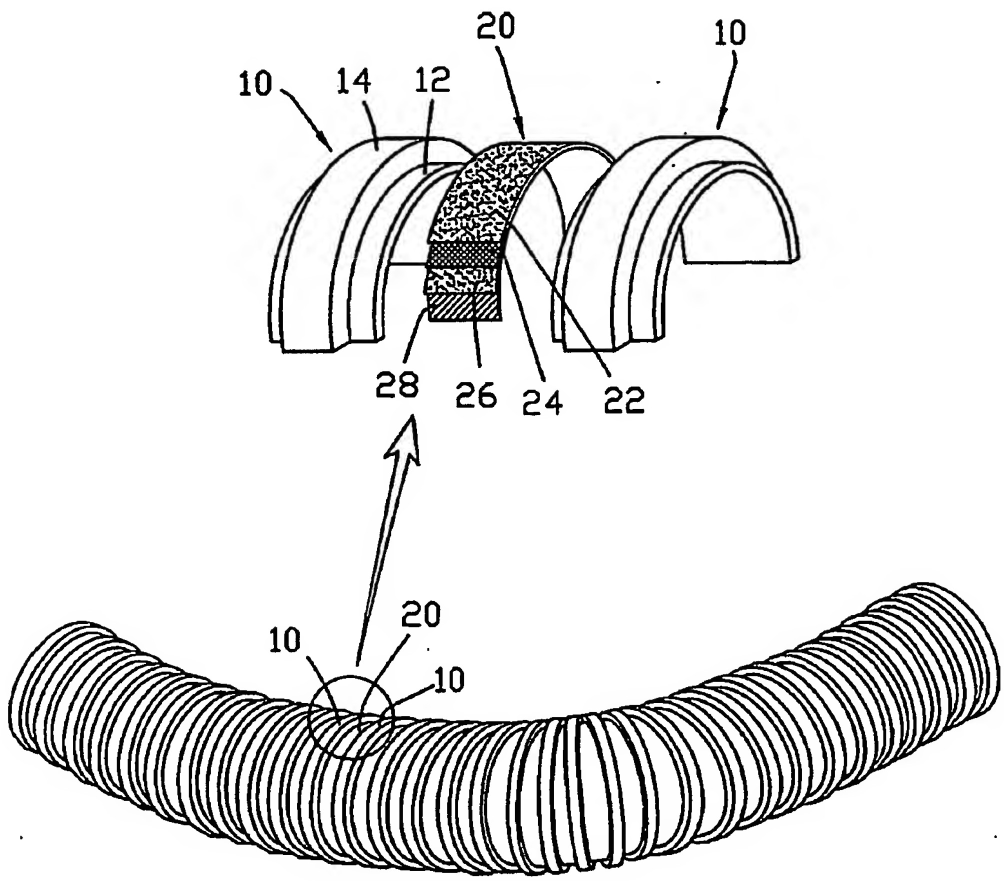
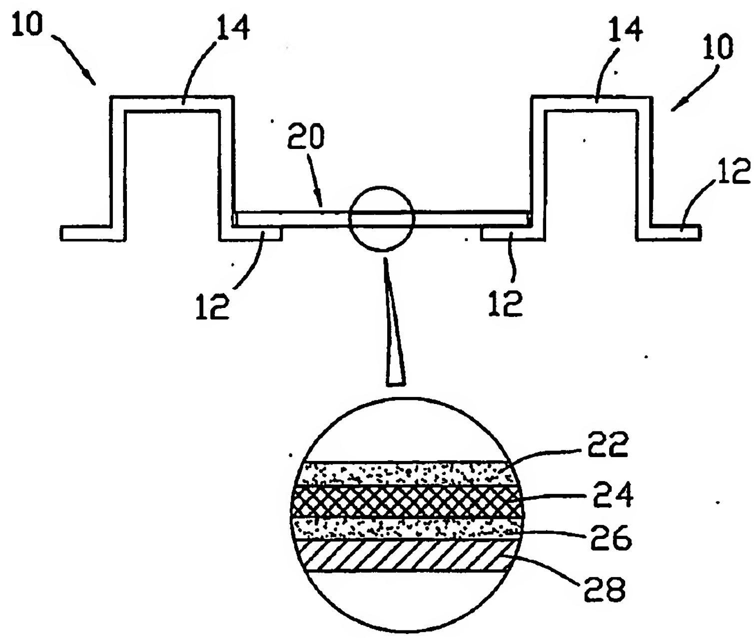


FIG 2



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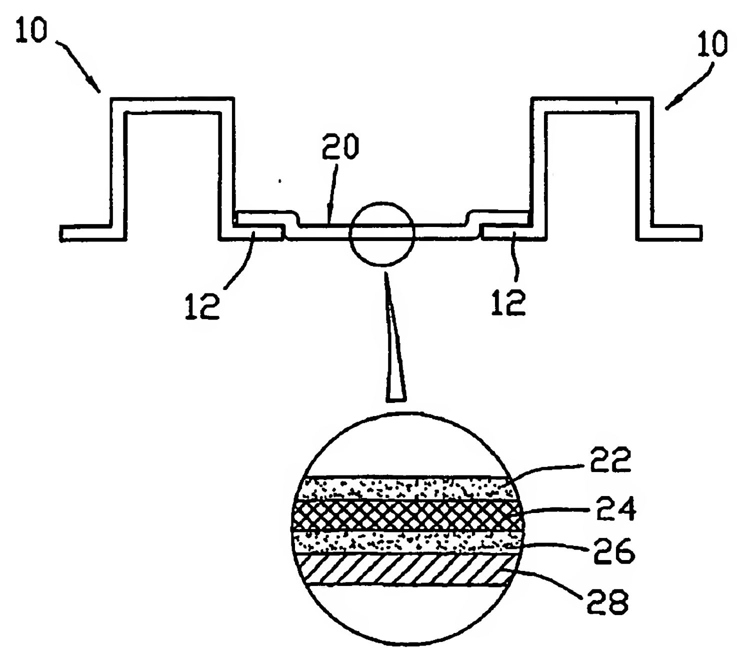

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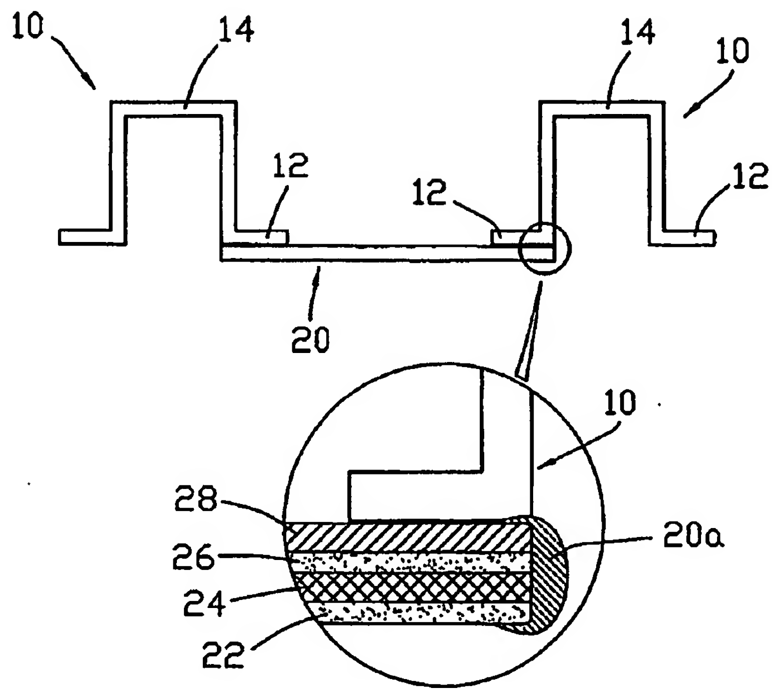
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FIG 5

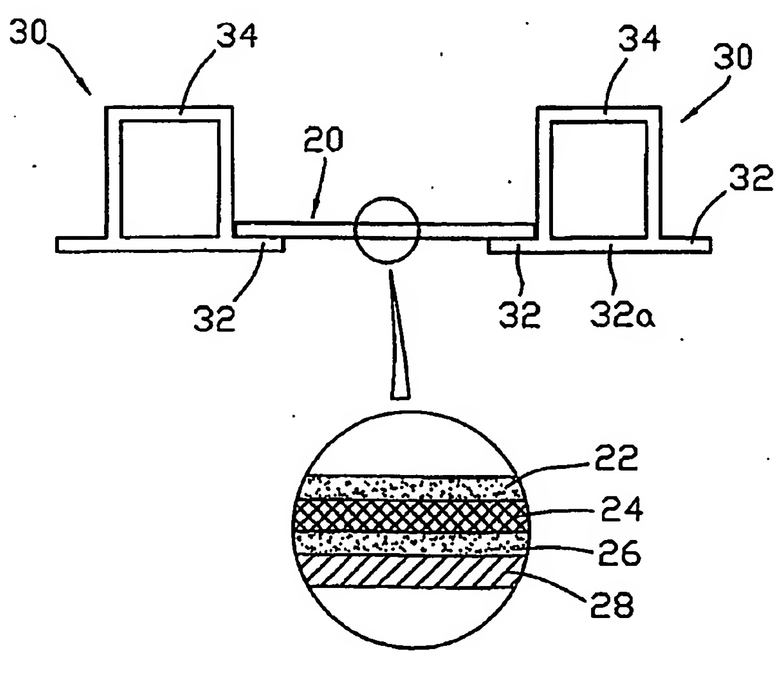
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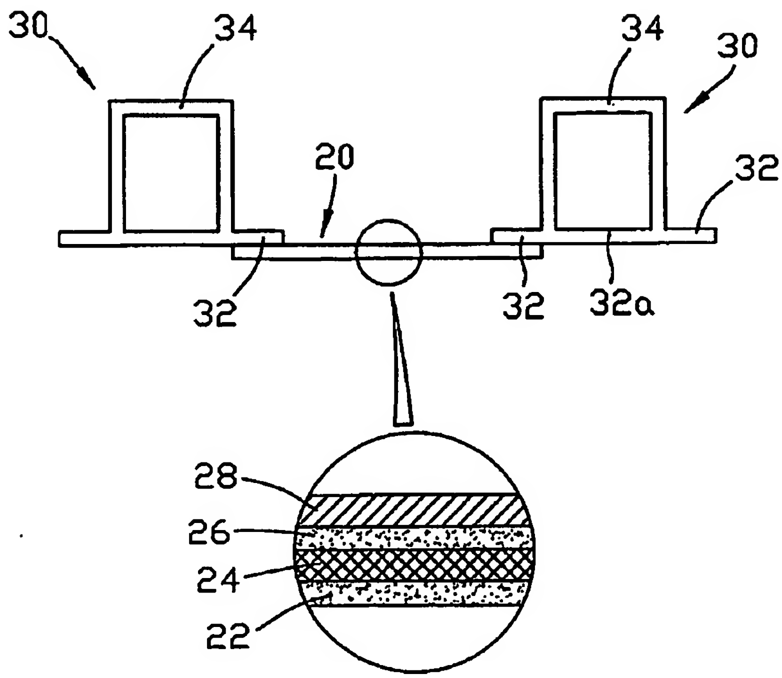
FIG 6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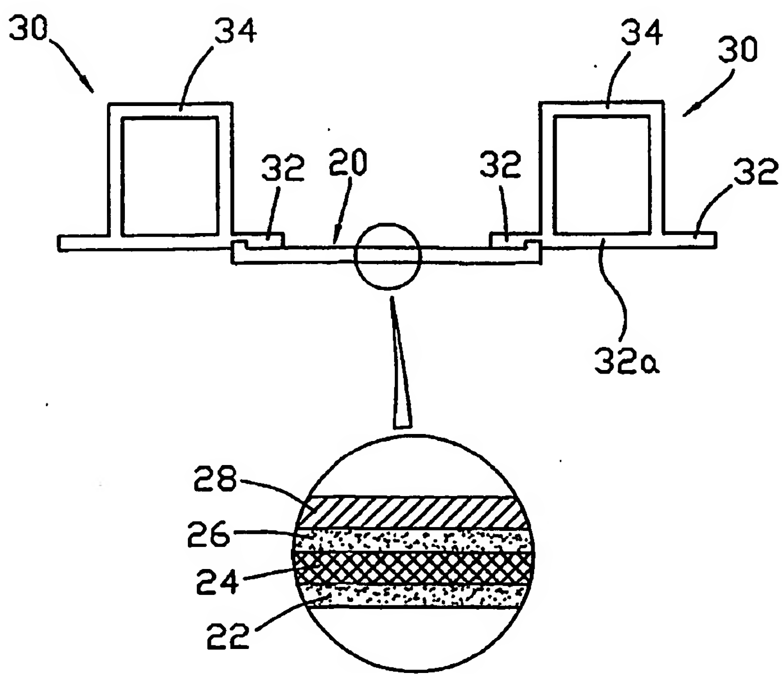
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FIG 8

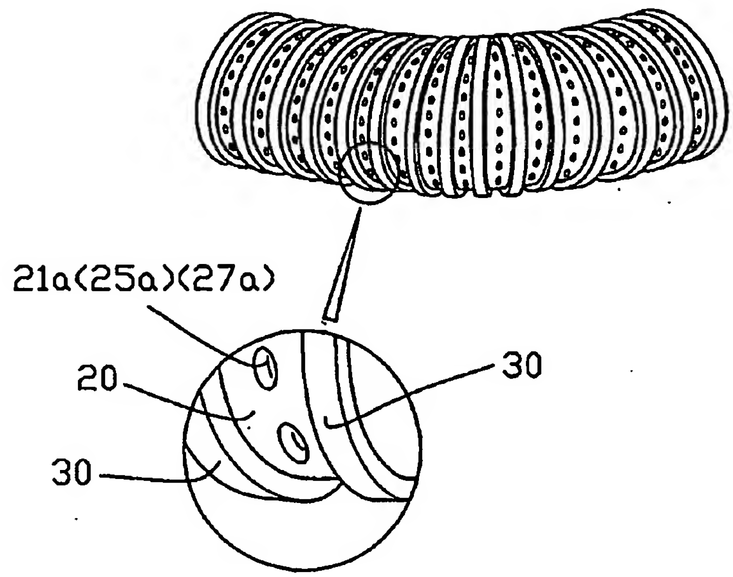
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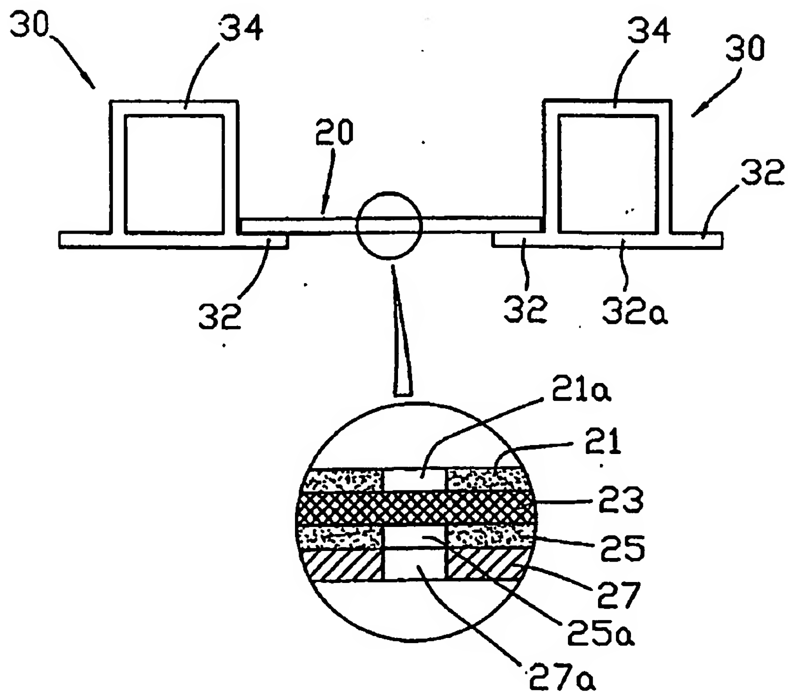
FIG 9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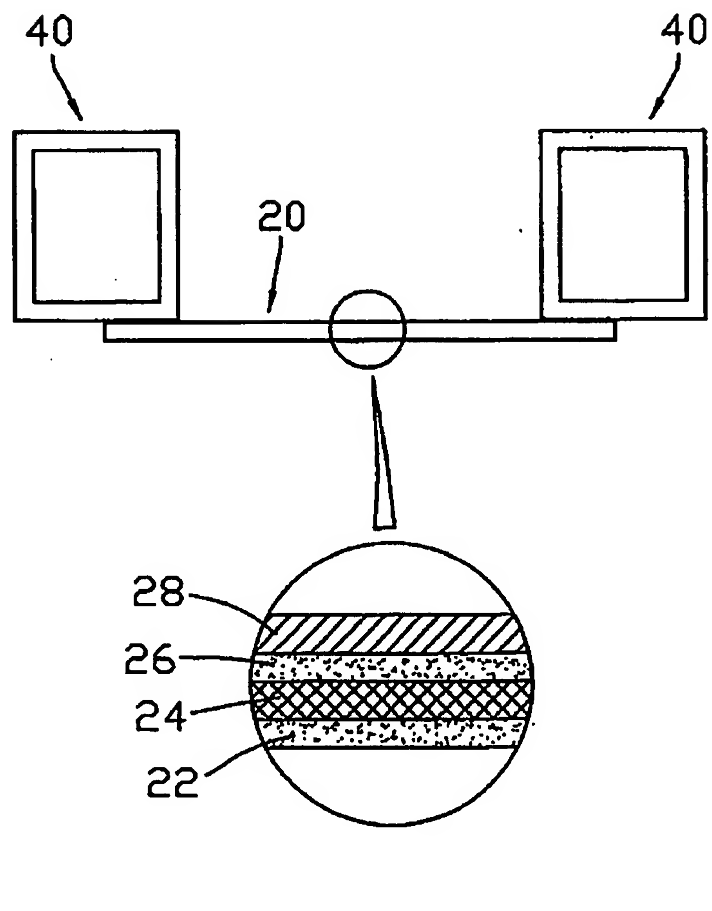

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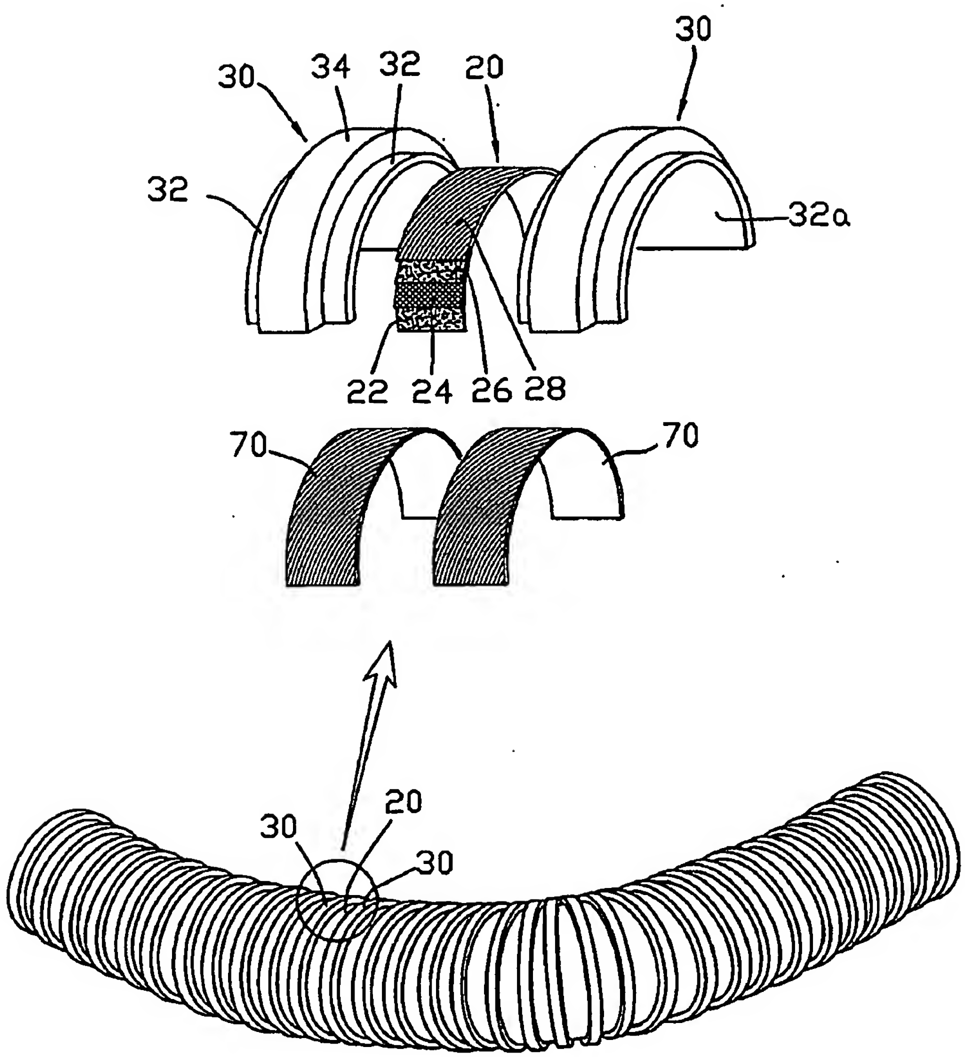

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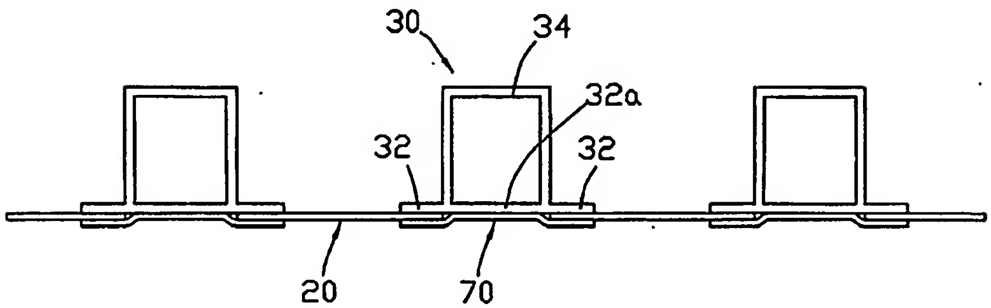

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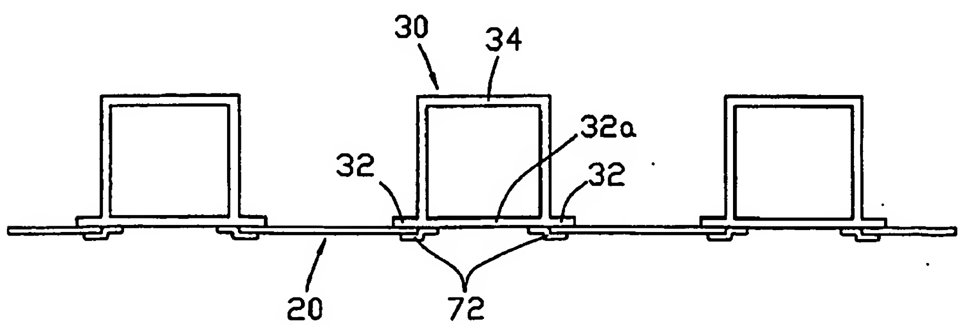

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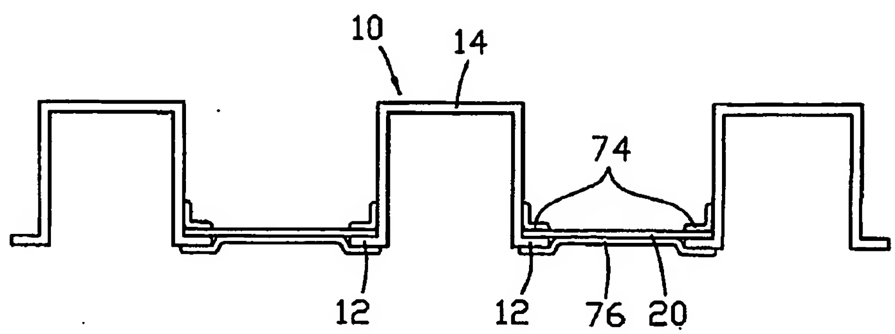

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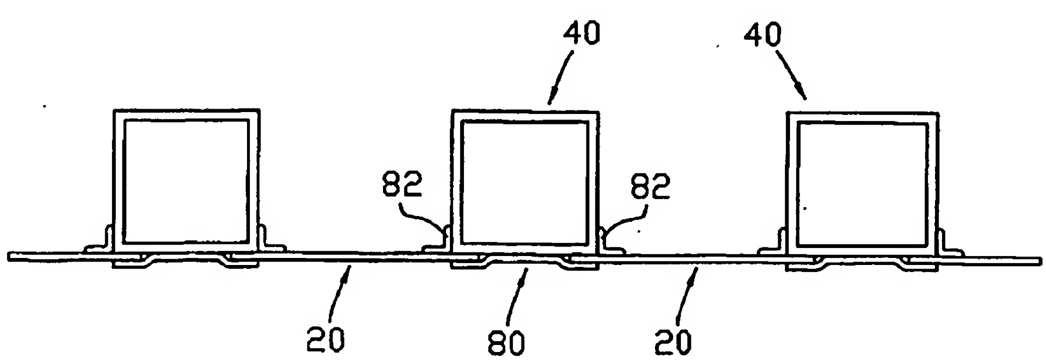

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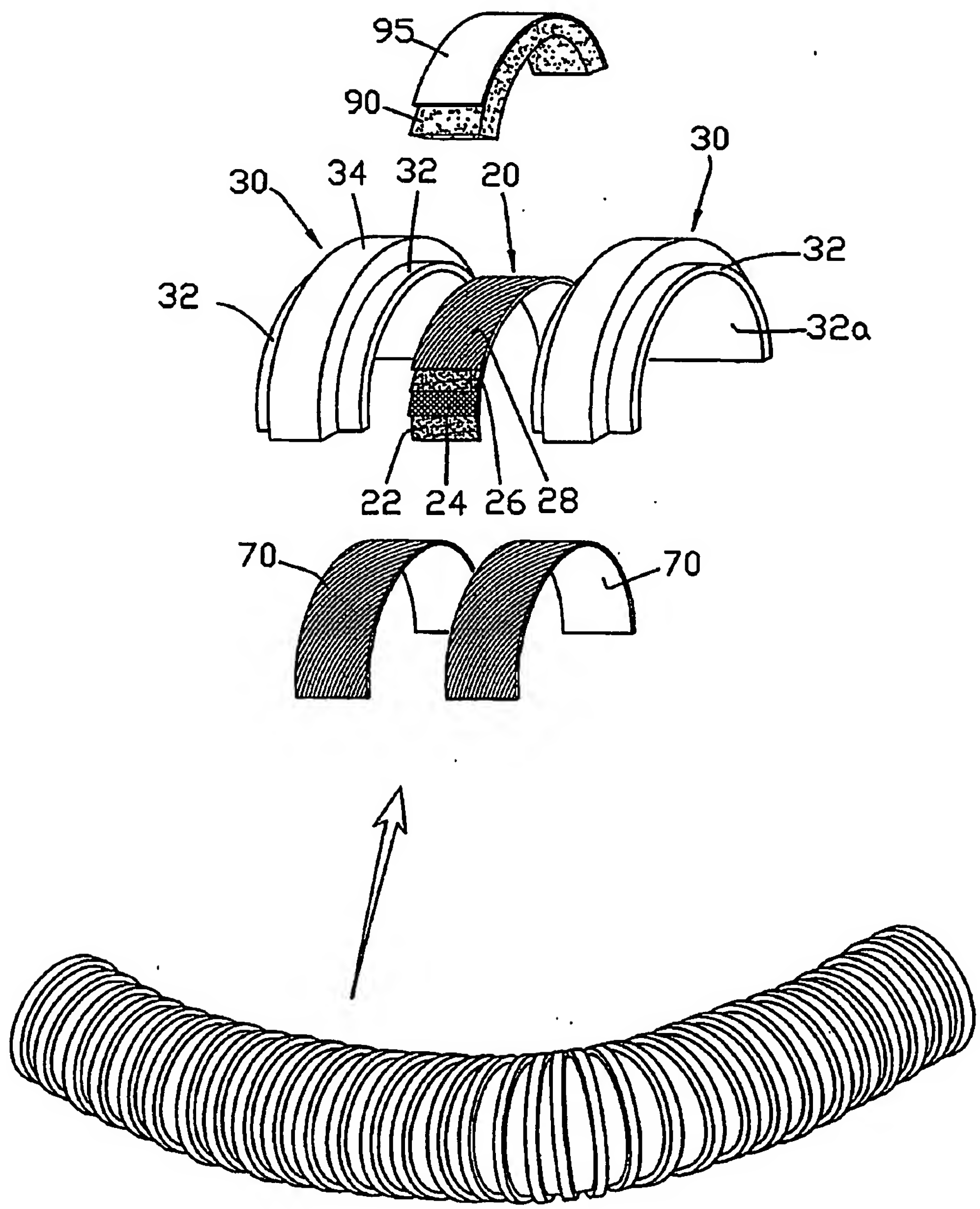

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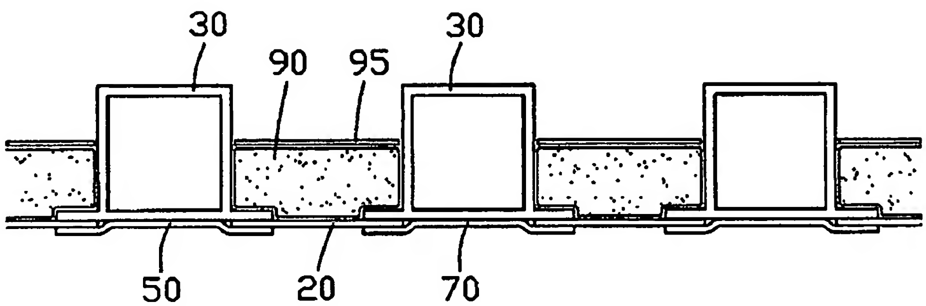

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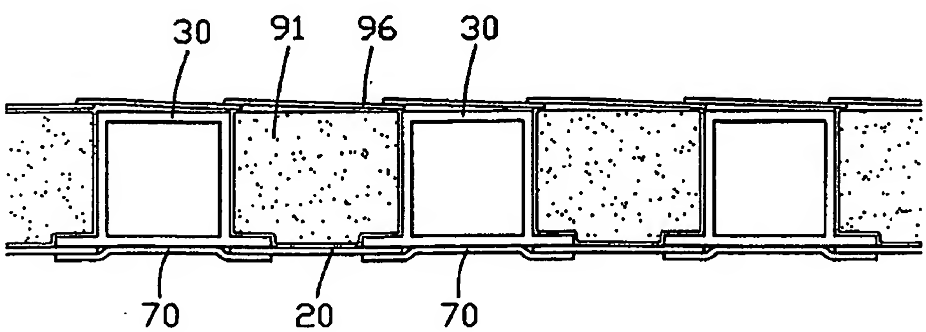

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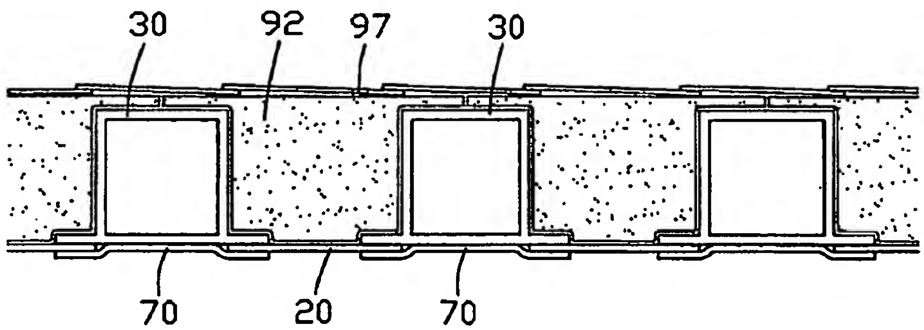

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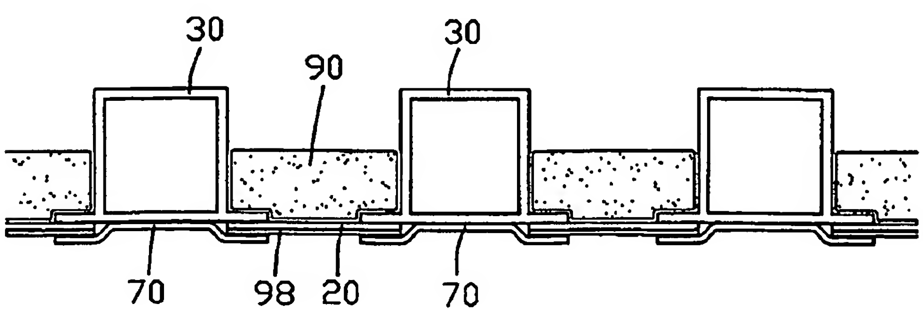

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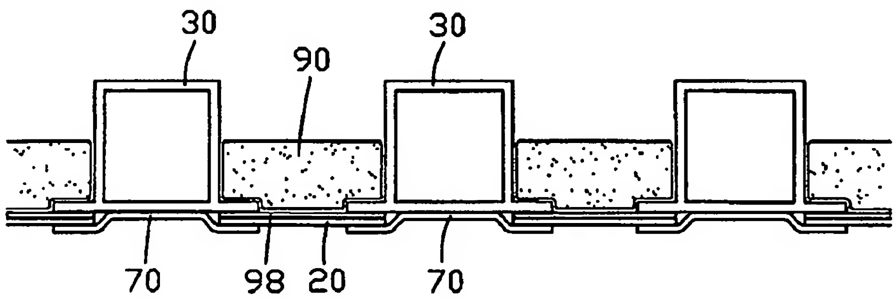

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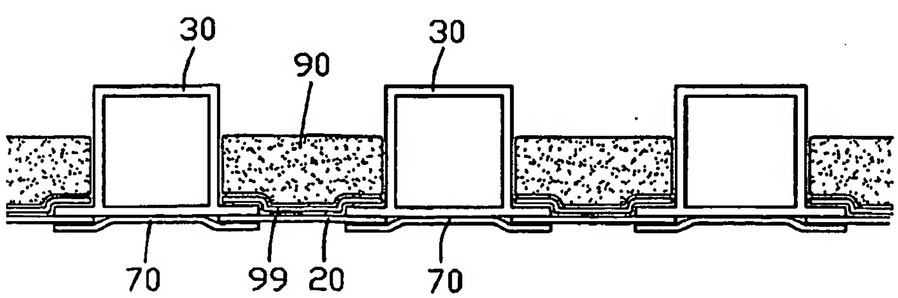

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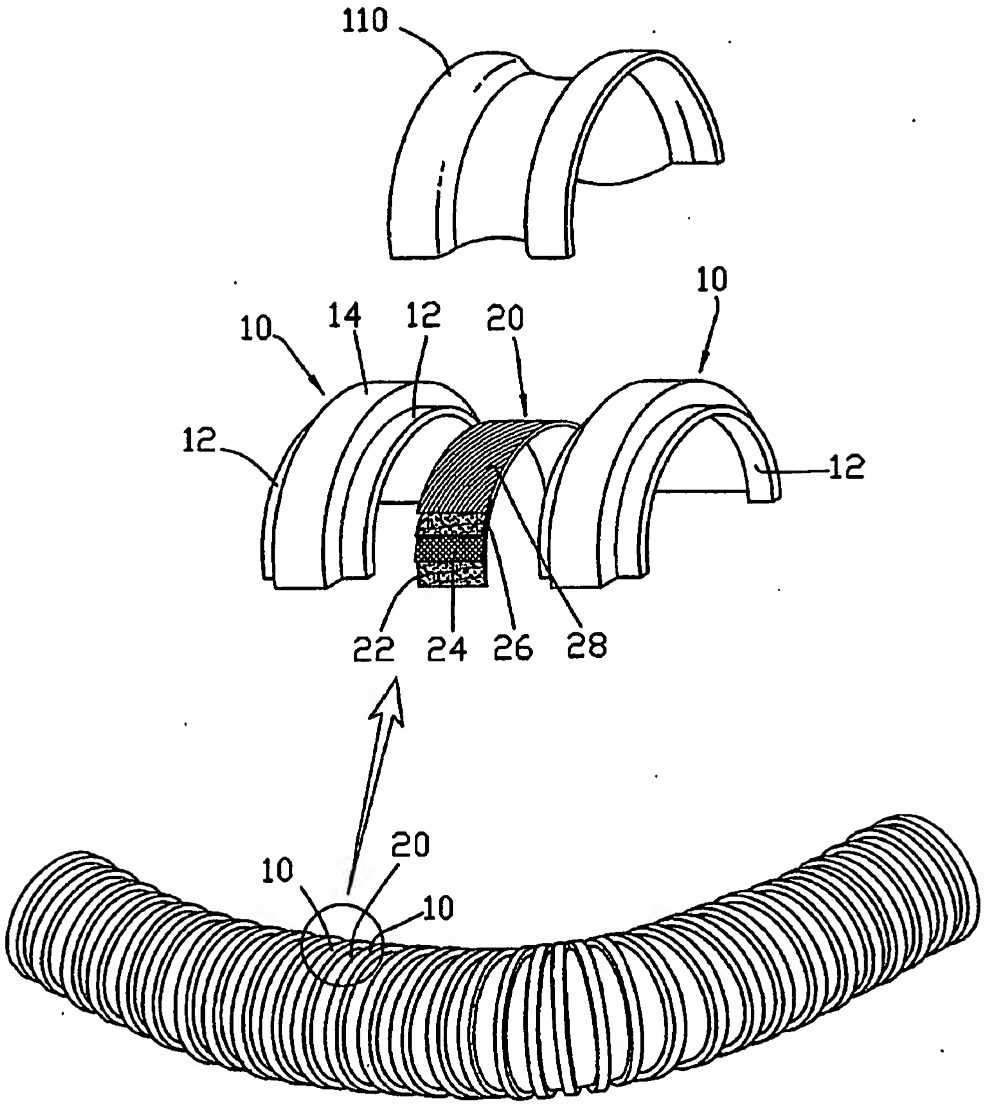

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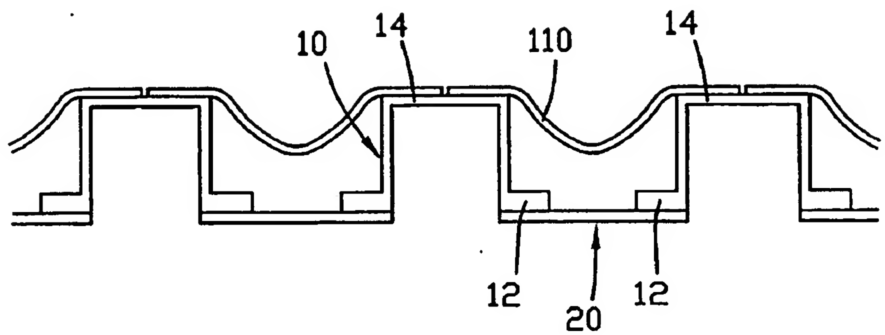

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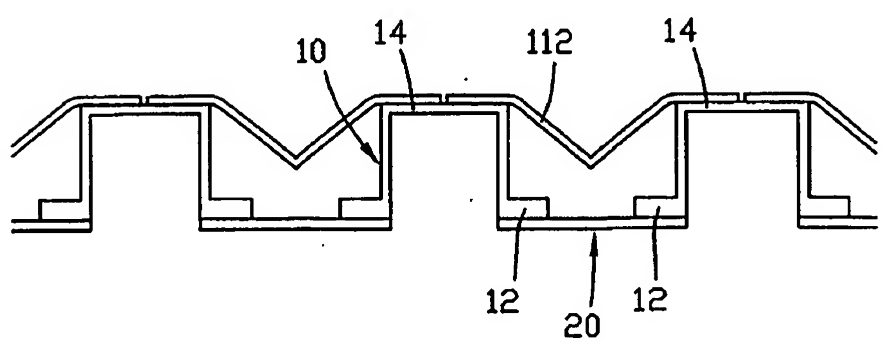

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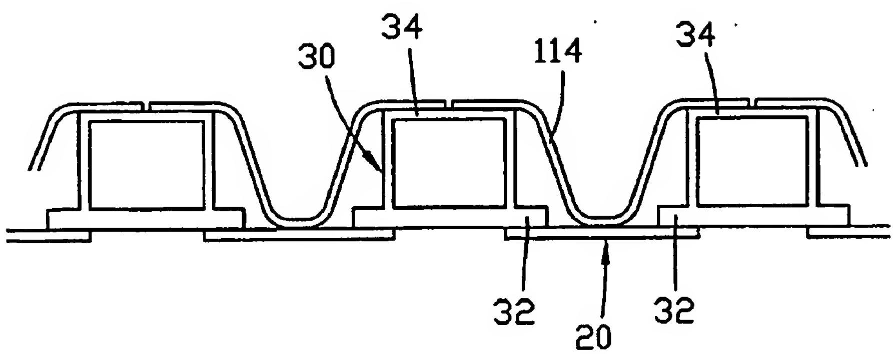

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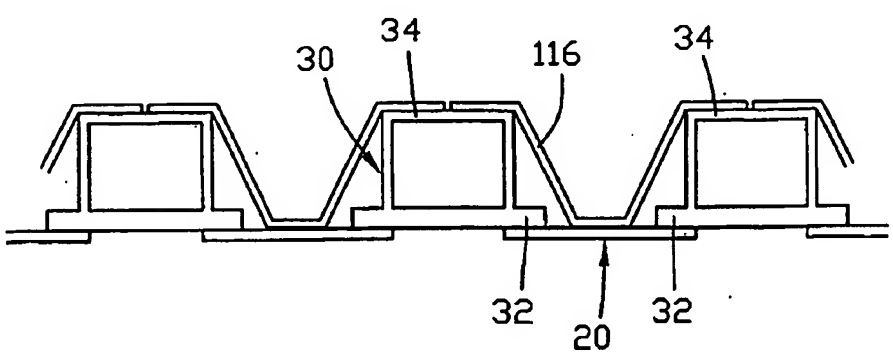

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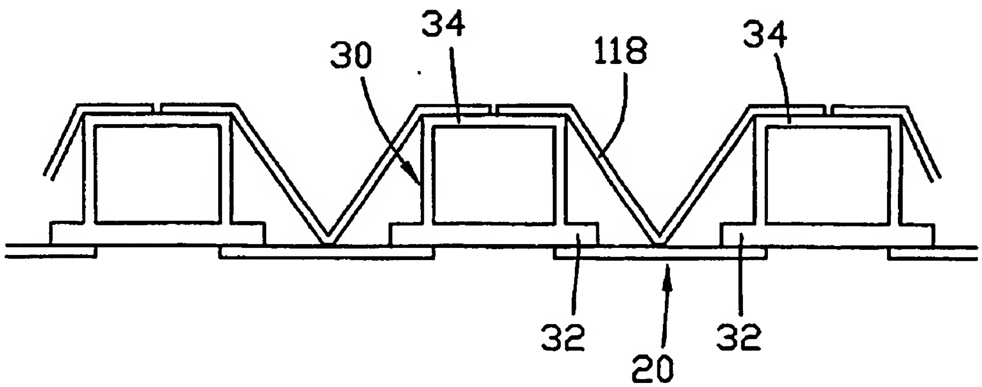

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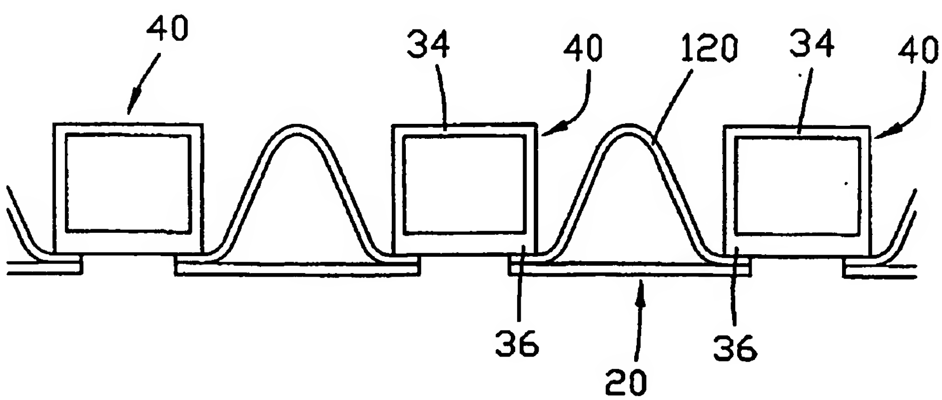

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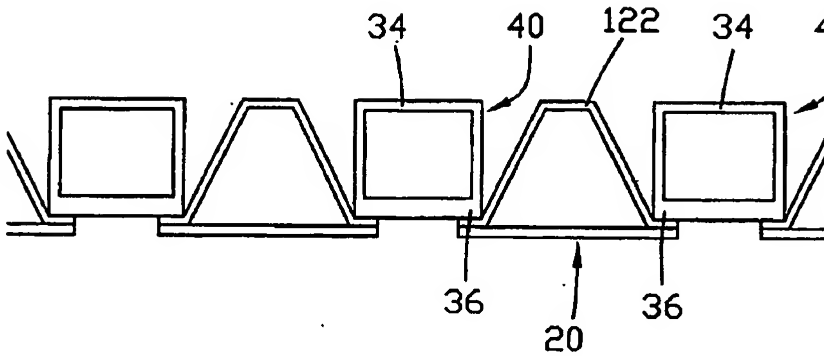

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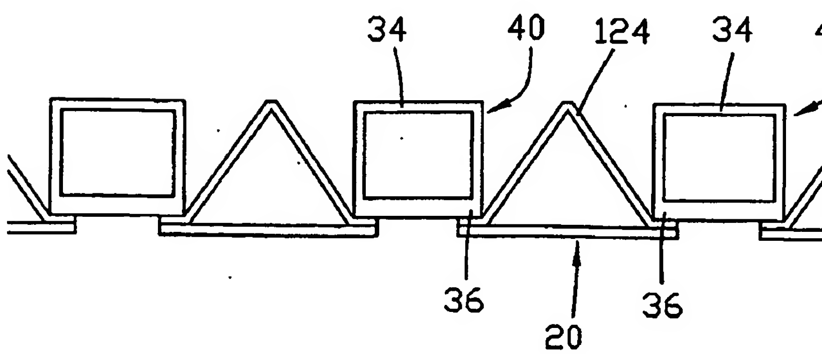

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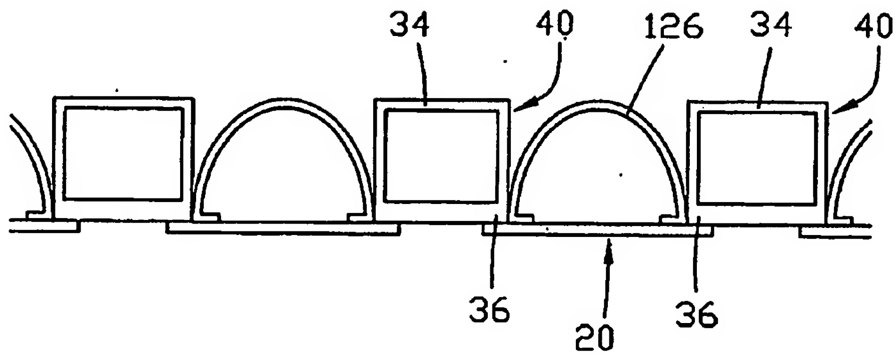

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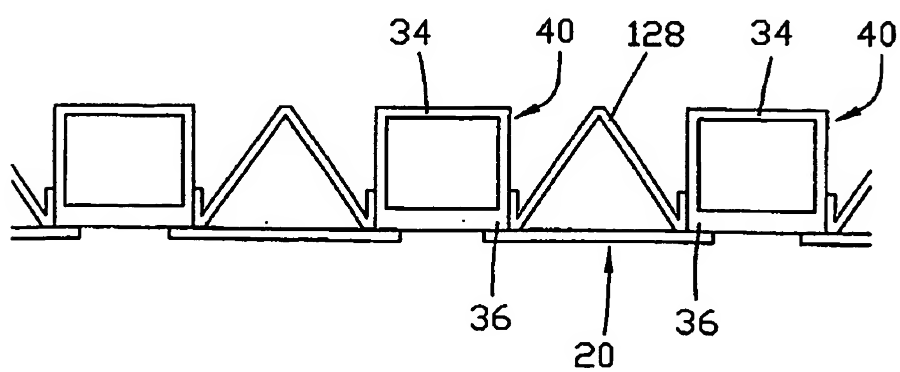

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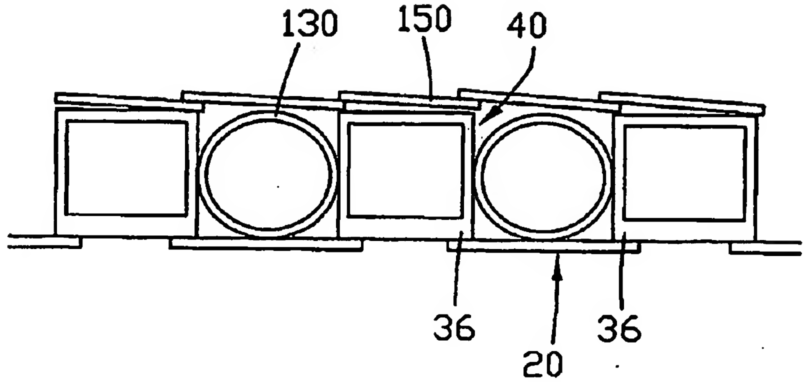

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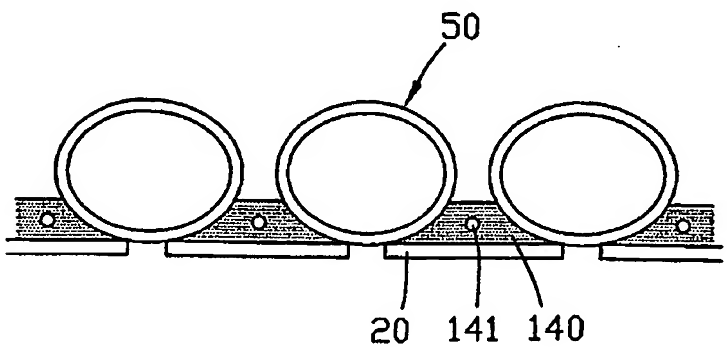

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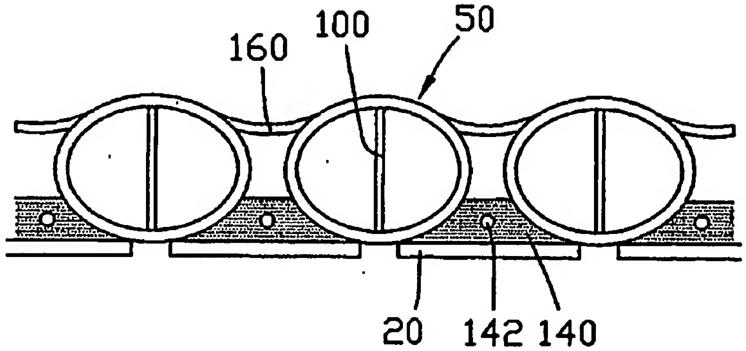
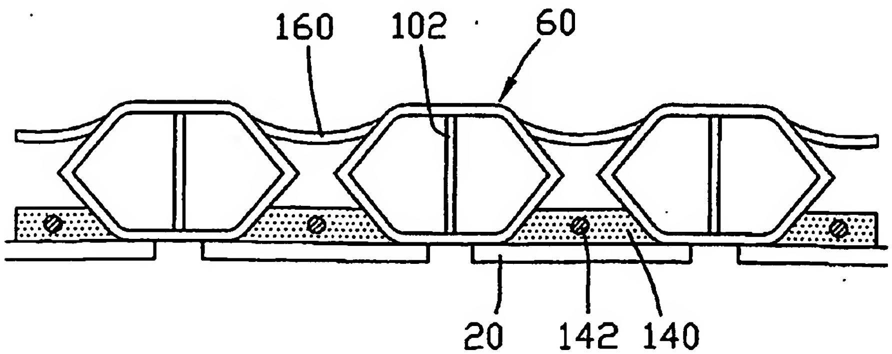


FIG 37



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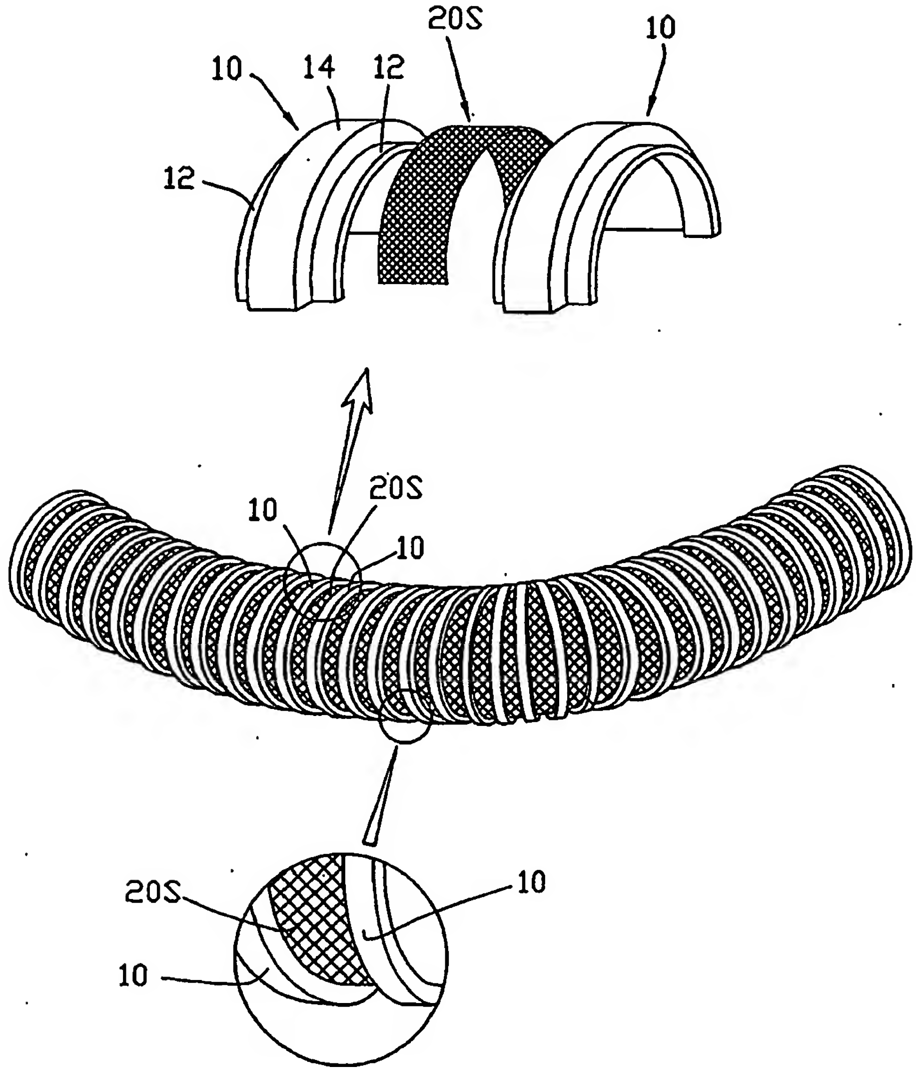

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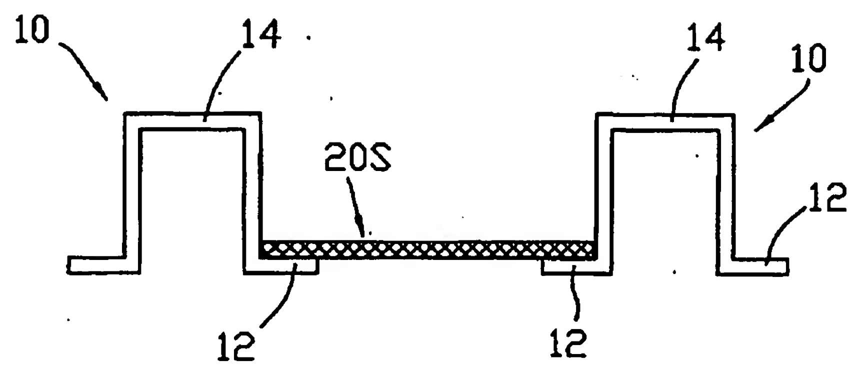


FIG 40

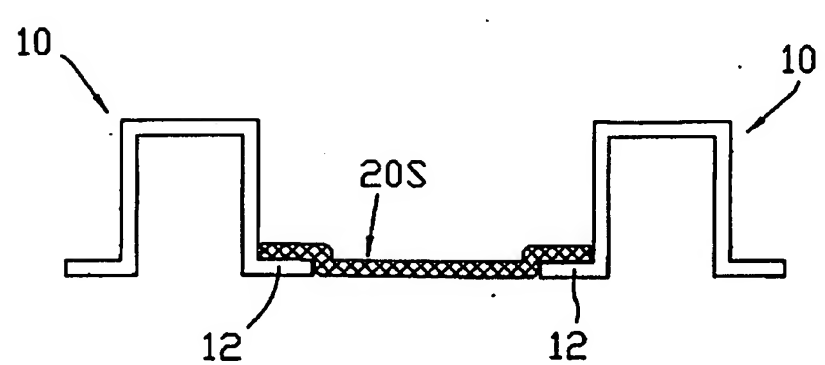


FIG 41

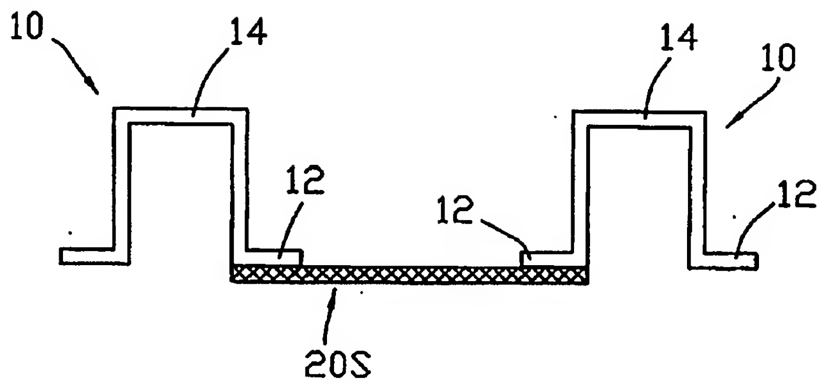


FIG 42

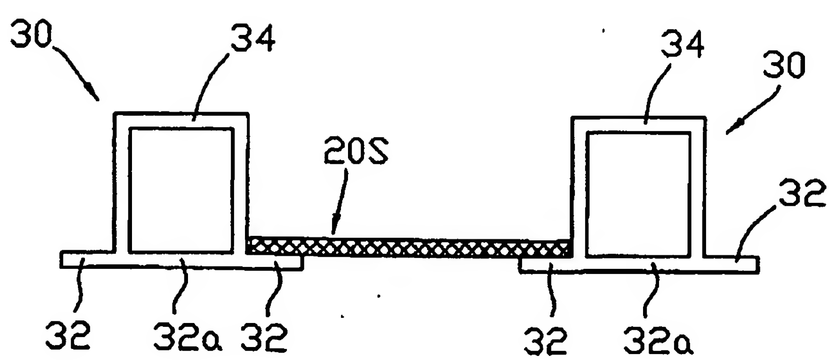


FIG 43

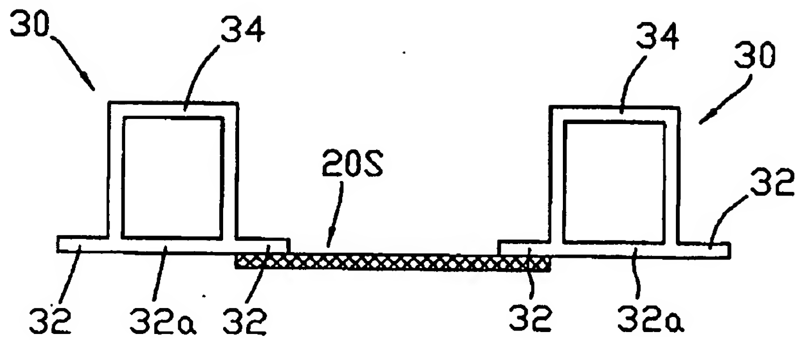


FIG 44

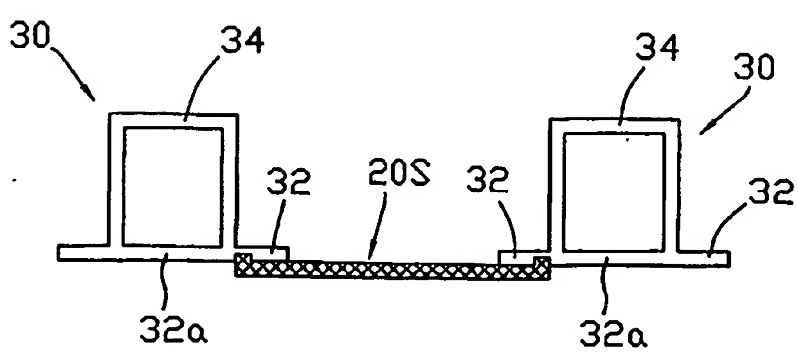


FIG 45

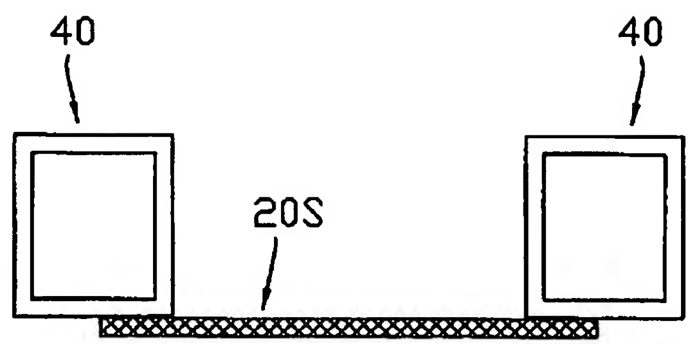


FIG 46

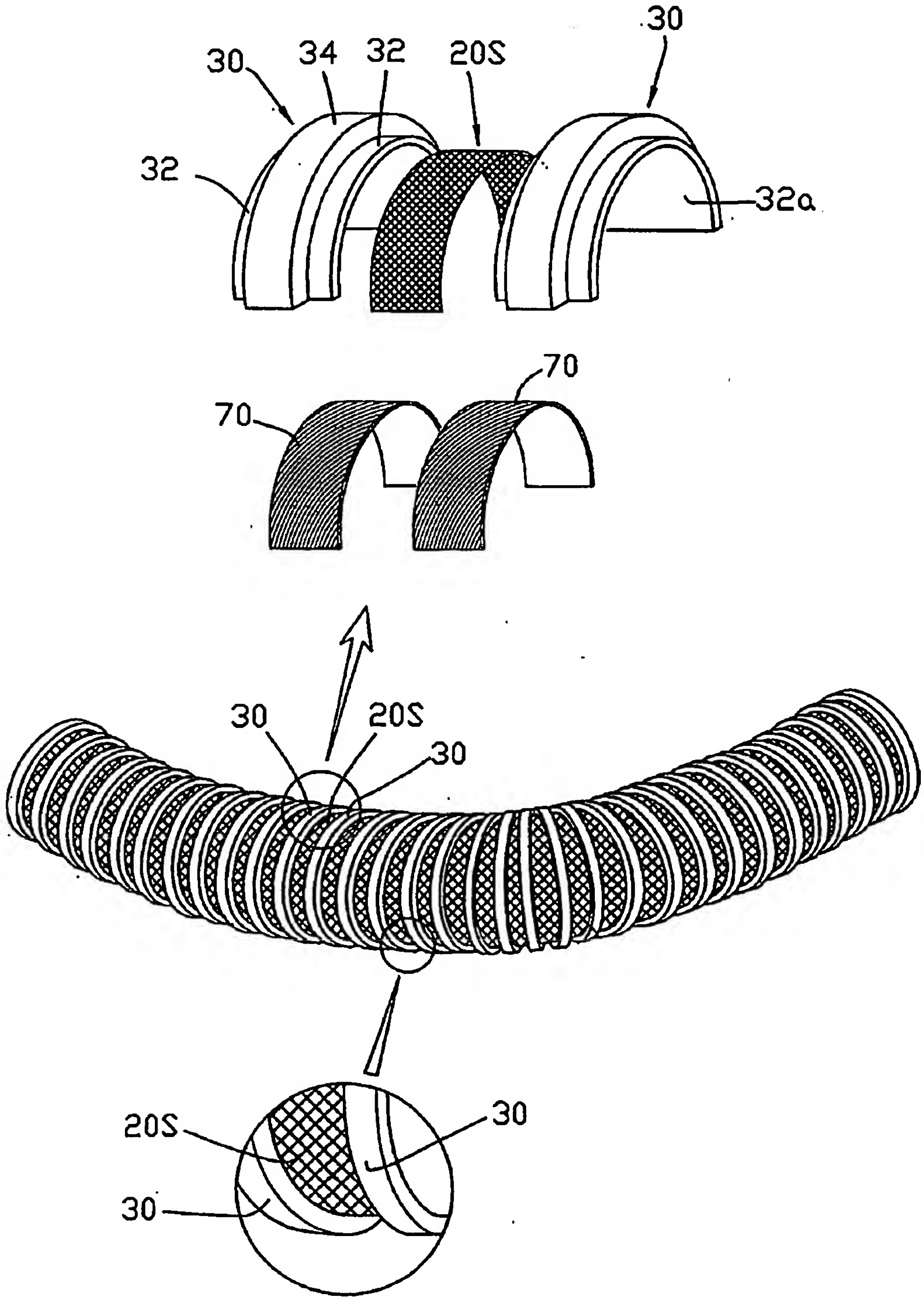


FIG 47

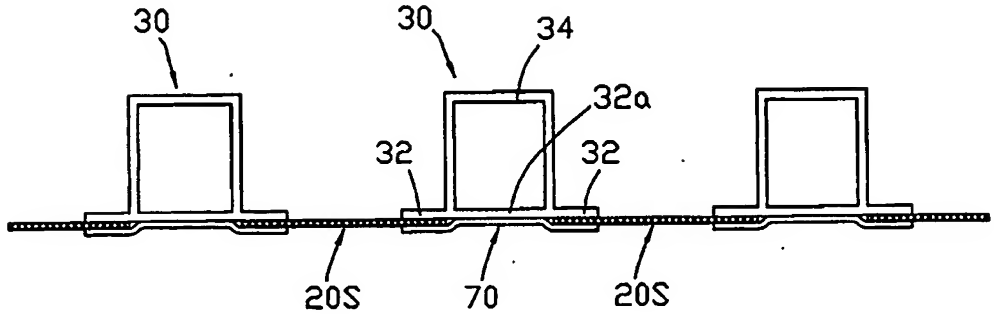


FIG 48

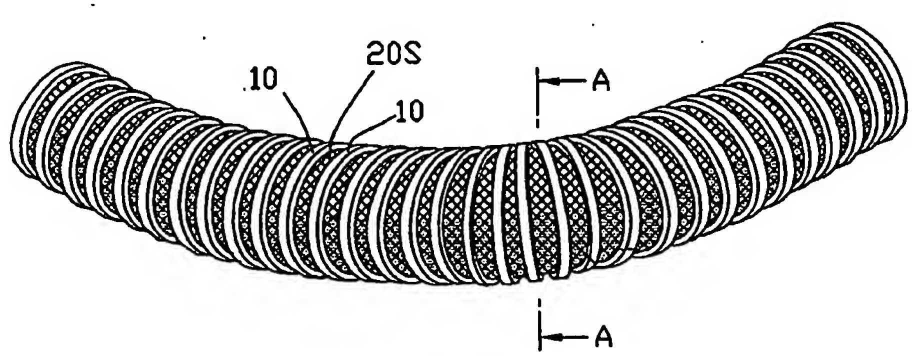


FIG 49

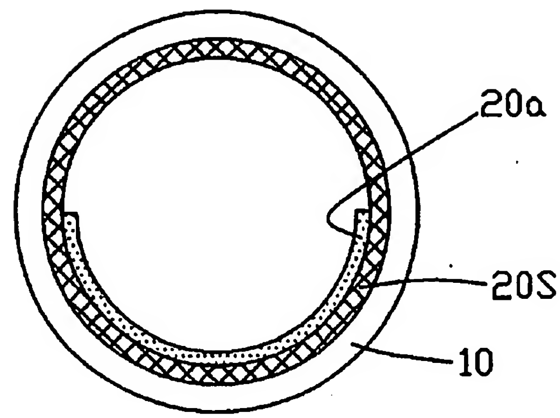


FIG 50

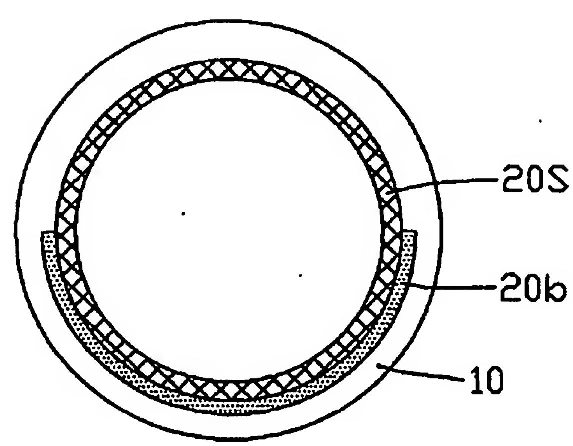


FIG 51

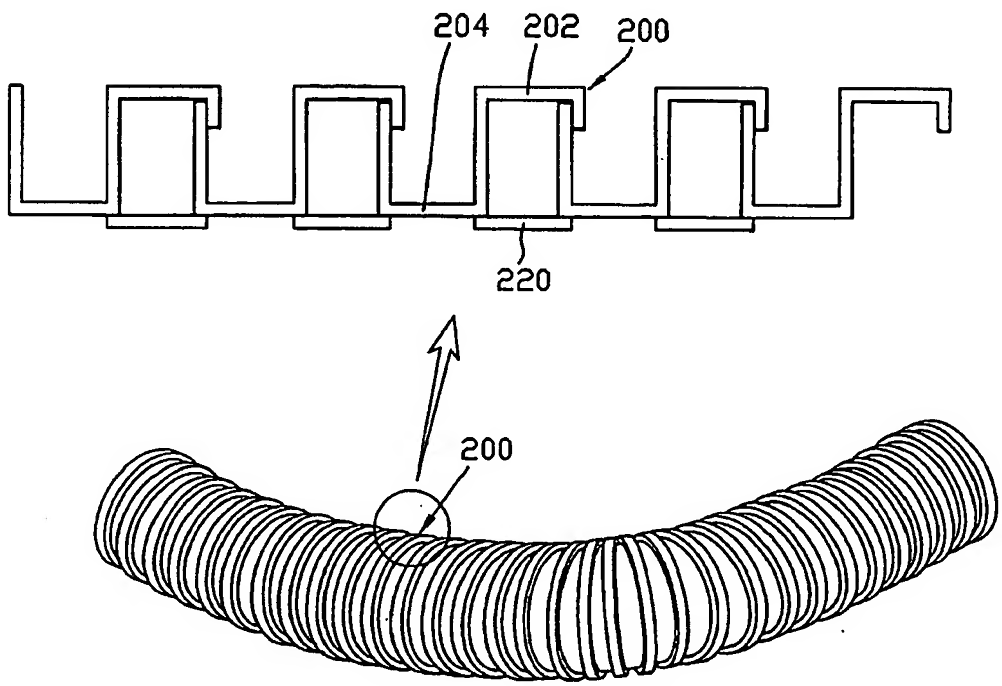


FIG 52

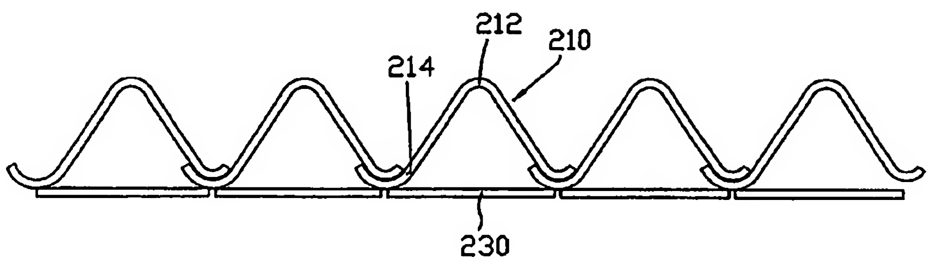


FIG 53

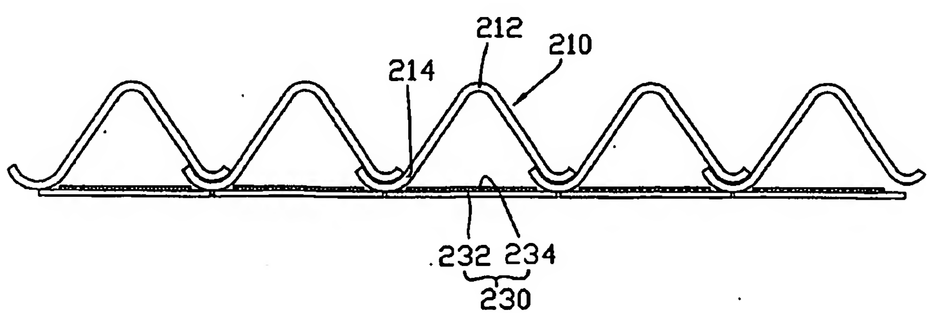


FIG 54

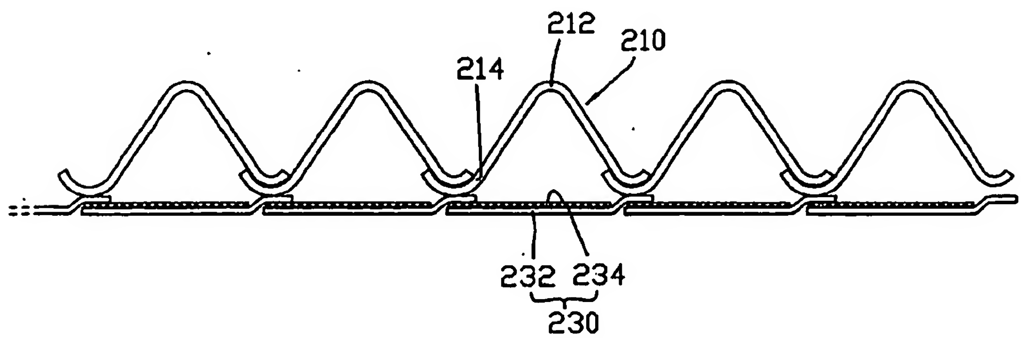


FIG 55

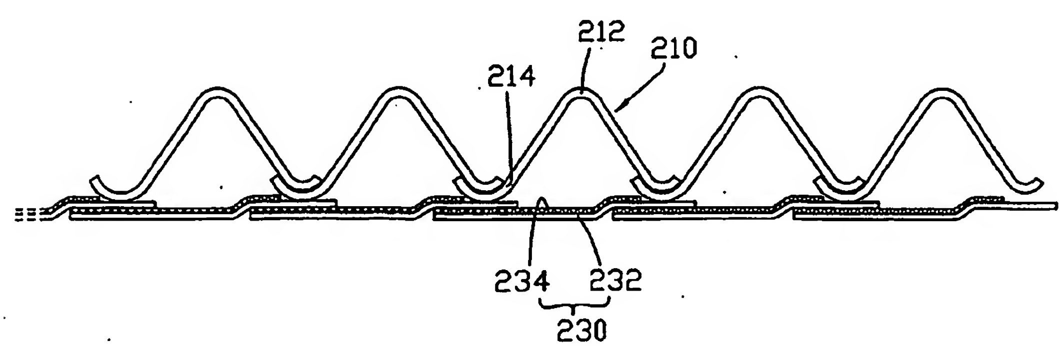
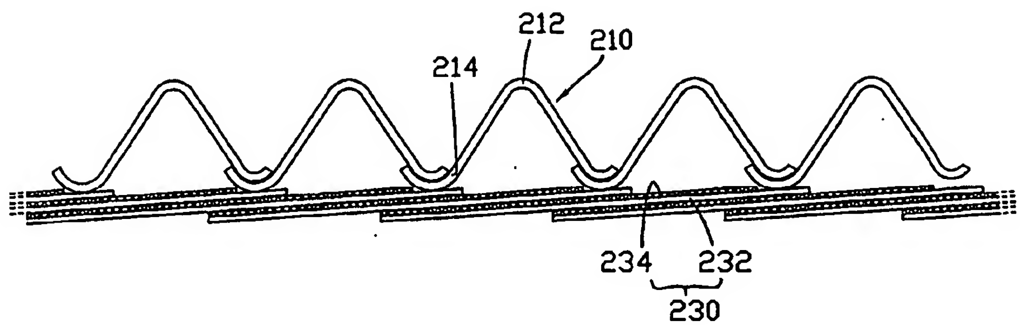


FIG 56



SPIRAL HOSE USING POLYETHYLENE

TECHNICAL FIELD

[0001] The present invention relates to a spiral hose, and more particularly to. a spiral hose, and more particularly to a spiral hose which includes a hard spiral member made from polyethylene and a thin soft spiral member made from polyethylene tarpaulin, and which can be used not only as a general hose but also as a gas duct or a watering hose.

BACKGROUND ART

[0002] In general, spiral hoses are used in pumping up and transferring liquid such as water. It is required that water should be prevented from leaking through the entire wall of the spiral hose, that inner surfaces of the spiral hose be prevented from adhering to each other by the pressure of the water passing through the spiral hose, and that the spiral hose have flexibility, in contrast with a usual pipe.

[0003] A spiral hose currently used includes a hard spiral member protruding outward and bearing the pressure of the water in the hose and a soft spiral member providing flexibility, which together forms a shape of the spiral hose.

[0004] The soft spiral member is fabricated by adding a plasticizer to a polyvinyl chloride (PVC) having a specific gravity of about 1.2 to 1.5 so that the soft spiral member can have flexibility. Therefore, the soft spiral member should have a considerable thickness in order to have a tensile strength capable of enduring the water pressure concentrated on the soft spiral member instead of the hard spiral member connected with both sides of the soft spiral member. As a result, the conventional spiral hose not only requires a high manufacturing cost but also has a large weight which requires much manpower and time in carrying or installing the conventional spiral hose.

[0005] Meanwhile, there has been often utilized a hose made from polyethylene having a specific gravity of about 0.9 with a uniform thickness. In this case, when the hose is made from polyethylene having a relatively large thickness in order to increase its resistance to internal pressure, the hose is too hard to have flexibility. Therefore, the polyethylene hose cannot be employed as a spiral hose for middle or high pressure but has been employed as a very thin spiral hose for ultra-low pressure.

DISCLOSURE OF THE INVENTION

[0006] The present invention has been made in view of the above-mentioned problems, in consideration of the fact that polyethylene tarpaulin has a higher tensile strength while being much thinner than PVC.

[0007] Therefore, it is an object of the present invention to provide a spiral hose utilizing polyethylene, in which a hard member made from polyethylene has a sectional shape protruding outward with angular corners and extends in a spiral shape, and a soft member made from polyethylene tarpaulin with a small thickness is attached to the hard member while extending along a spiral gap formed between each turns of the spiral hard member, so that the spiral hose has not only a sufficient resistance to internal pressure owing to the hard polyethylene member but also a high tensile strength and excellent flexibility owing to the soft member made from polyethylene tarpaulin, and so that, in comparison with a PVC hose, the spiral hose having the same resistance to pressure can be manufactured at a lower cost and has smaller weight which enables the spiral hose to be easily carried and installed.

[0008] It is another object of the present invention to provide a spiral hose utilizing polyethylene, in which a coated polyethylene tarpaulin layer forming a soft member has a plurality of spray holes, so that the spiral hose may be utilized as a watering hose.

[0009] It is another object of the present invention to provide a spiral hose utilizing polyethylene, in which each interval between wefts and between warps of a woven polyethylene fabric layer has a wide distance of 5 to 20 mm, so that the spiral hose can be employed as a gas duct which can be bent more than 90° when the duct is installed.

[0010] It is another object of the present invention to provide a spiral hose utilizing polyethylene, which includes a hard member and a soft member attached to each other, and a fastening band attached along a joint portion between the hard and soft members, so that the hard and soft members can be water-tightly assembled together without a separate coating and with an increased cohesion between the hard and soft members.

[0011] It is another object of the present invention to provide a spiral hose utilizing polyethylene, in which a hard spiral member and a soft spiral member are assembled with each other while extending in a spiral shape, respectively, and a heat-insulation foam fixed in a spiral gap formed between turns of the hard spiral member, so that the spiral hose has an adiabatic characteristic without a separate heat-insulation cover.

[0012] It is another object of the present invention to provide a spiral hose utilizing polyethylene, which includes a hard spiral member and a soft spiral member assembled with each other while extending in a spiral shape, and a reinforcement member disposed along a spiral groove above the soft spiral member while connecting turns of the hard spiral member with each other, so as to reinforce the strength of the soft spiral member and uniformly maintain the spiral gap between the turns of the hard spiral member, thereby preventing the spiral hose from being expanded and contracted and highly improving the durability and marketability of the spiral hose.

[0013] It is another object of the present invention to provide a spiral hose utilizing polyethylene, which includes not only a hard spiral member and a soft spiral member attached to each other, but also a reinforcement piece disposed across the hollow space of the hard spiral member, which prevents the hard spiral member from being deformed by external force and prevents the strength and the draining function of the spiral hose from being deteriorated due to the possible deformation of the hard spiral member.

[0014] It is another object of the present invention to provide a watering hose utilizing polyethylene, in which a hard member made from polyethylene extends in a spiral shape with a spiral gap between turns of the hard member, and a soft member made from woven polyethylene fabrics is attached to the hard member while extending along the spiral gap, so that the watering hose has not only a sufficient resistance to internal pressure owing to the hard polyethylene member but also a high tensile strength and excellent

flexibility owing to the soft member made from polyethylene tarpaulin, and can be manufactured at a lower cost and simplified process, thereby highly improving the productivity.

[0015] It is another object of the present invention to provide a watering hose utilizing polyethylene, which can be formed of a single polyethylene member wound in a spiral shape, so that the manufacturing process of the spiral hose can be simplified to thereby increase the productivity, and the joint portions of the single polyethylene member can have a stronger cohesion to thereby improve the durability of the spiral hose.

[0016] It is another object of the present invention to provide a watering hose utilizing polyethylene, which includes a polyethylene member having convex and concave portions and extending in a spiral shape, and a reinforcement band connected to adjacent concave portions to each other at each turn of the spirally wound polyethylene member to close the inner space of the convex portion, thereby increasing the strength of the spiral hose, preventing deformation of the spiral hose, and highly improving the durability of the spiral hose.

[0017] According to an aspect of the present invention, there is provided a spiral hose utilizing polyethylene wound in a spiral shape to have flexibility, the spiral hose comprising: a hard member made from polyethylene, which is wound in a spiral shape with a uniform spiral gap formed between turns of the hard member; and a soft member having a shape of a band and being formed of polyethylene tarpaulin, the soft member being disposed along the spiral gap while lateral edges of the soft member are fixed to portions of the hard member, which are disposed oppositely on both sides of the spiral gap.

[0018] The hard member may comprise a convex section protruding upward with angular corners and flanges extending laterally from lower ends of the convex section, and the lateral edges of the soft spiral member are attached to the flanges disposed oppositely on both sides of the spiral gap. In this case, the hard spiral member assembled with the soft member is bent and protrudes outward, and the flanges are integrally connected with each other, so as to form a space inside of the hard member.

[0019] The soft member may comprise a woven polyethylene fabric layer and at least one polyethylene coating layer coated on the woven polyethylene fabric layer, the polyethylene coating layer having a plurality of spray holes, so that the spiral hose can be used as a watering hose.

[0020] The soft member may be formed of polyethylene tarpaulin which includes a woven polyethylene fabric layer and at least one polyethylene coating layer coated on at least one surface of the woven polyethylene fabric layer, or may be formed of polyethylene tarpaulin, which includes a woven polyethylene fabric layer and low-density and high-density polyethylene coating layers coated in sequence on at least one surface of the woven polyethylene fabric layer.

[0021] Further, the soft member may be formed of polyethylene tarpaulin, both side edges of which are fixed to outer or inner surfaces of the flanges of the hard member, respectively. In this case, side ends of the polyethylene tarpaulin forming the soft spiral member are coated to form watertight ends.

[0022] The spiral hose may further comprise a fastening band attached along a joint portion between the hard member and the soft member.

[0023] Also, the spiral hose may further comprise a heat-insulation foam fixed in a spiral gap formed between turns of the hard member and on the soft member.

[0024] In this case, the hard member may be made from high-density polyethylene, the soft member is formed of polyethylene tarpaulin, and the heat-insulation foam is formed of polyethylene foam.

[0025] The spiral hose may further comprise an aluminum foil attached to an upper surface of the heat-insulation foam or an outer surface of the spiral hose. In the latter case, the hard member and the heat-insulation foam together form the outer surface of the spiral hose, and the aluminum foil is wound around the outer surface of the spiral hose in a spiral shape, thereby forming an outermost layer of the spiral hose.

[0026] The spiral hose may further comprise aluminum foils attached in sequence to one surface of the soft member or an aluminum foil having a shape of a band, which is attached to a lower surface of the heat-insulation foam. In this case, the reinforcement member may be made from soft material, may be fixed on the soft member, and may have transverse side ends fixed to both sides of the hard member, thereby maintaining a uniform between turns of the hard member.

[0027] In this case, the hard member and reinforcement member may be made from polyethylene, and the soft member may be made from at least one of polyethylene tarpaulin and soft polyethylene.

[0028] The reinforcement member may be a flexure cover which has side edges attached to adjacent side portions of an upper surface of the hard spiral member and a central portion being concave downward in a transverse sectional view of the flexure cover. The central portion of the flexure cover concave downward is fixed to an upper surface of the soft member disposed under the flexure cover.

[0029] The reinforcement member may be a flexure cover which has side edges and a central portion, the side edges being fixed between side edges of the soft member and side portions of a lower surface of the hard member, the central portion being concave upward in a transverse sectional view of the flexure cover.

[0030] The reinforcement member may be a flexure cover which has side edges and a central portion, the side edges being fixed onto an exposed surface of the soft member, the central portion being concave upward in a transverse sectional view of the flexure cover.

[0031] Also, the reinforcement member may be a flexure cover which has side edges and a central portion, the side edges being fixed to lower portions of side surfaces of the hard member, which are disposed both side of the soft member at each turn of the hard member, the central portion being concave upward in a transverse sectional view of the flexure cover.

[0032] The reinforcement member may be a hollow flexible member fixed in the spiral gap formed on the soft member, the hollow flexible member having outer side portions attached to adjacent outer side surfaces of the hard

member. In this case, the spiral hose may further comprise a protection cover attached on the hollow flexible member, the protection cover having flexibility and forming the outer surface of the spiral hose. Preferably, the protection cover is made from at least one of polyethylene tarpaulin and soft polyethylene.

[0033] Further, the hard member has a hollow sectional shape, and the reinforcement member is a flexible lamination fixed to an upper surface of the soft member and filled in a lower portion of the spiral gap between turns of the hard spiral member. In this case, the flexible lamination has a plurality of holes, each of which is formed through a central portion of each turn of the flexible lamination in a sectional view of the flexible lamination. The spiral hose may further comprise a plurality of reinforcement cores inserted in said holes formed through the central portion of each turn of the flexible lamination. Also, the flexible lamination may be made from soft polyethylene, and the reinforcement cores are made from high-density polyethylene.

[0034] Also, the spiral hose may further comprise a soft cover having a band shape, the soft cover having lateral sides attached to upper portions of the hard member at both sides of the spiral gap.

[0035] The spiral hose may further comprise a reinforcement piece disposed across a center of a hollow space in the hard member.

[0036] In accordance with another aspect of the present invention, the present invention provides a watering hose utilizing polyethylene wound in a spiral shape to have flexibility, the watering hose comprising: a hard member made from polyethylene, which is wound in a spiral shape with a uniform spiral gap formed between turns of the hard member; and a soft member having a shape of a band and being formed of polyethylene tarpaulin, the soft member being disposed along the spiral gap while lateral edges of the soft member are fixed to portions of the hard member, which are disposed oppositely on both sides of the spiral gap.

[0037] In this case, the hard member may comprise a convex section protruding upward with angular corners and flanges extending laterally from lower ends of the convex section, and the lateral edges of the soft spiral member are attached to the flanges disposed oppositely on both sides of the spiral gap. In this case, the hard spiral member assembled with the soft member is bent and protrudes outward, and the flanges are integrally connected with each other, so as to form a base section which defines a closed space inside of the hard member.

[0038] The soft member may have side edges fixed to outer or inner surfaces of the flanges of the hard member. Also, the watering hose may further comprise a soft polyethylene film having a band shape, the soft polyethylene film being attached to an exposed portion of a lower surface of the base section and side portions of the soft member disposed at both sides of the exposed portion.

[0039] The watering hose may further comprise a coated film formed on a lower portion of the inner surface of the watering hose, so as to block gaps formed through a lower portion of a woven polyethylene fabric layer of the soft member or a coated film formed between the hard member and the soft member, so as to block gaps formed through a lower portion of a woven polyethylene fabric layer of the soft member.

[0040] In accordance with another aspect of the present invention, the present invention provides a spiral hose utilizing polyethylene, which includes a polyethylene member having a band shape, the polyethylene member comprising a convex portion and a concave portion adjacent to each other in a transverse sectional view of the polyethylene member, the polyethylene member being wound in a spiral shape while a plurality of the convex portions and a plurality of the concave portions are alternately engaged with and fused to each other, so as to form an integral spiral hose.

[0041] In this case, each of the convex portions and concave portions may have a rectangular shape in a transverse sectional view of the polyethylene member or the convex portion and the concave portion integrated with each other may form a shape like a sine wave in a transverse sectional view of the polyethylene member.

[0042] The spiral hose may further comprise a reinforcement band attached to at least two lower side ends of the concave portion disposed at either side of the convex portion so as to form a closed space inside of the convex portion. The reinforcement band may be made from at least one of polyethylene tarpaulin and soft polyethylene.

[0043] Further, the reinforcement band may be formed of a soft polyethylene layer and a polyethylene tarpaulin layer, the polyethylene tarpaulin layer having a width smaller than that of the soft polyethylene layer, the polyethylene tarpaulin layer being attached along a central portion of the soft polyethylene layer in a transverse view of the soft polyethylene layer so that edge portions of the soft polyethylene layer are exposed.

[0044] Also, the reinforcement band may be formed of a soft polyethylene layer and a polyethylene tarpaulin layer, the polyethylene tarpaulin layer having a width smaller than that of the soft polyethylene layer, the polyethylene tarpaulin layer being attached to an upper surface of a first side portion of the soft polyethylene layer in a transverse view of the soft polyethylene layer so that a second side portion of the soft polyethylene layer are exposed, the second side portion being attached to a lower surface of the first side portion in a transverse view of the soft polyethylene layer.

[0045] Moreover, the second side portion may be attached to the lower surface of the first side portion of the soft polyethylene layer while covering at least one adjacent concave portion, so that turns of the soft polyethylene layer overlapping on each other at each concave portion of the soft polyethylene layer form a lamination including at least two layers.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] The foregoing and other objects, features and advantages of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings in which:

[0047] **FIG. 1** is a perspective view of a spiral hose utilizing polyethylene according to an embodiment of the present invention;

[0048] **FIG. 2** is a partial sectional view of a portion of the spiral hose shown in **FIG. 2**;

[0049] **FIG. 3** is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0050] FIG. 4 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0051] FIG. 5 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0052] FIG. 6 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0053] FIG. 7 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0054] FIG. 8 is a perspective view of a spiral hose according to another embodiment of the present invention, which is used as a watering hose having spray holes;

[0055] FIG. 9 is a partial sectional view of FIG. 8;

[0056] FIG. 10 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0057] FIG. 11 is a perspective view of a spiral hose according to another embodiment of the present invention;

[0058] FIG. 12 is a partial sectional view of FIG. 11;

[0059] FIG. 13 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0060] FIG. 14 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0061] FIG. 15 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0062] FIG. 16 is a perspective view of a spiral hose according to another embodiment of the present invention;

[0063] FIG. 17 is a partial sectional view of FIG. 16;

[0064] FIG. 18 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0065] FIG. 19 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0066] FIG. 20 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0067] FIG. 21 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0068] FIG. 22 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0069] FIG. 23 is a perspective view of a spiral hose according to another embodiment of the present invention;

[0070] FIG. 24 is a partial sectional view of FIG. 23;

[0071] FIG. 25 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0072] FIGS. 26 to 37 are partial sectional views of spiral hoses according to other embodiments of the present invention;

[0073] FIG. 38 is a perspective view of a watering hose according to another embodiment of the present invention;

[0074] FIG. 39 is a partial sectional view of FIG. 38;

[0075] FIG. 40 is a partial sectional view of a watering hose according to another embodiment of the present invention;

[0076] FIG. 41 is a partial sectional view of a watering hose according to another embodiment of the present invention;

[0077] FIG. 42 is a partial sectional view of a watering hose according to another embodiment of the present invention;

[0078] FIG. 43 is a partial sectional view of a watering hose according to another embodiment of the present invention;

[0079] FIG. 44 is a partial sectional view of a watering hose according to another embodiment of the present invention;

[0080] FIG. 45 is a partial sectional view of a watering hose according to another embodiment of the present invention;

[0081] FIG. 46 is a perspective view of a watering hose according to another embodiment of the present invention;

[0082] FIG. 47 is a partial sectional view of FIG. 46;

[0083] FIG. 48 is a perspective view of a watering hose according to another embodiment of the present invention;

[0084] FIG. 49 is a sectional view taken along line A-A of FIG. 48;

[0085] FIG. 50 is a side sectional view of a watering hose according to another embodiment of the present invention;

[0086] FIG. 51 is a perspective view of a spiral hose according to another embodiment of the present invention;

[0087] FIG. 52 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0088] FIG. 53 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0089] FIG. 54 is a partial sectional view of a spiral hose according to another embodiment of the present invention;

[0090] FIG. 55 is a partial sectional view of a spiral hose according to another embodiment of the present invention; and

[0091] FIG. 56 is a partial sectional view of a spiral hose according to another embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0092] Reference will now be made in detail to the preferred embodiments of the present invention.

[0093] Embodiment 1

[0094] FIG. 1 is a perspective view of a spiral hose utilizing polyethylene according to the first embodiment of the present invention, and FIG. 2 is a sectional view of a portion of the spiral hose shown in FIG. 1. As shown, a spiral hose according to the present invention includes a hard spiral member 10 and a soft spiral member 20 assembled with each other.

[0095] The hard spiral member 10 is made from polyethylene and extends in a shape of a coil spring with a spiral gap having a uniform width between turns of the coil spring. In a sectional view, the hard spiral member 10 includes a

convex section **14** protruding upward with angular corners and flanges **12** which extend laterally from lower ends of the convex section **14**.

[0096] Additionally, the soft spiral member **20** has a shape of a band and is made of polyethylene tarpaulin formed by coating woven polyethylene fabrics. The soft spiral member **20** is disposed along the spiral gap between turns of the hard spiral member **10**, while lateral edges of the soft spiral member **20** are fixed to the flanges **12** disposed oppositely on both sides of the spiral gap. In other words, the hard spiral member **10** and the soft spiral member **20** each extending in a spiral shape are attached to each other in the way described above, thereby forming the spiral hose according to the present invention.

[0097] In the spiral hose according to the present invention described above, the hard spiral member **10** made from polyethylene is bent and protrudes outward to form a space inside thereof, so that opposed inner surfaces of the spiral hose do not adhere to each other and the spiral hose can maintain its original shape even when a strong suction pressure is formed inside the spiral hose. Further, in the spiral hose, the soft spiral member **20** disposed in the gap between turns of the hard spiral member **10** is made of polyethylene tarpaulin having a high tensile strength and flexibility despite a small thickness, so that the spiral hose can sufficiently endure a strong pressure by water, etc., sucked by a pump.

[0098] The spiral hose according to the present invention can have the same resistance-to-pressure and flexibility as those of a PVC hose having a weight four times larger than that of the spiral hose. Therefore, the present invention reduces not only cost for manufacturing a hose but also manpower and time for installing or carrying the hose.

[0099] Polyethylene tarpaulin is material used mainly for tents. In polyethylene tarpaulin, only the tensile strengths of wefts and warps of a woven polyethylene fabric layer and the tensile strength of a polyethylene coating layer enough to endure the pressure of water flowing in the polyethylene coating layer, are considered as important factors. However, gaps between the wefts and warps, through which water may leak, are neglected. Therefore, a usual polyethylene tarpaulin implies a polyethylene tarpaulin made by coating a woven polyethylene fabric layer with a low-density polyethylene layer which has a tensile strength (which relates to the breaking point) of only 120 to 140 kg/cm^2.

[0100] In a spiral hose according to the present invention, the polyethylene tarpaulin, the material of the soft spiral member **20**, may be a usual tarpaulin formed by coating a low-density polyethylene layer **22** or **26** on at least one surface of a woven polyethylene fabric layer **24**. However, in the case where the spiral hose is made of the polyethylene tarpaulin formed by coating only the low-density polyethylene layer **22** or **26** on the woven polyethylene fabric layer **24**, the coated low-density polyethylene layer **22** or **26** may be torn by the internal pressure of the spiral hose, so that the transferred water may leak through the gaps between wefts and warps of the woven polyethylene fabric layer **24**. Therefore, it is preferred that the soft spiral member **20** is made of a polyethylene tarpaulin formed by coating a low-density polyethylene layer **26** and a high-density polyethylene layer **28** in sequence on at least one surface of the woven polyethylene fabric layer **24**.

[0101] The high-density polyethylene layer **28** implies an ordinary high-density polyethylene tarpaulin having a density of about 0.941 to 0.965 g/cm^2 and a tensile strength of only 330 to 340 kg/cm^2, which is 2.5 times larger than that of the low-density polyethylene tarpaulin, thereby having nearly the same breaking point as that of the woven polyethylene fabric layer **24**, enough to endure the pressure of transferred water when the high-density polyethylene layer **28** has been coated on the woven polyethylene fabric layer **24**.

[0102] In coating the high-density polyethylene layer **28** as described above, the low-density polyethylene layer **26** having a low melting point is coated on one surface of the woven polyethylene fabric layer **24**, and then the high-density polyethylene layer **28** is coated on the other surface of the woven polyethylene fabric layer **24**. This is because, when the high-density polyethylene layer **28**, having as a high melting point as the woven polyethylene fabric layer **24** has, is coated directly on an outer surface of the woven polyethylene fabric layer **24**, the coated surface may come off instead of being in tight contact with the surface of the woven polyethylene fabric layer **24**.

[0103] The soft spiral member **20** described above, as shown in **FIGS. 1 and 2**, may be fixed to outer surfaces of the flanges **12** of the hard spiral member **10**. In this case, it is preferred that the inner surface of the soft spiral member **20**, which is in tight contact with the outer surfaces of the flanges **12** of the hard spiral member **10**, is formed of a high-density polyethylene coating layer capable of sufficiently enduring the internal pressure of the hose.

[0104] In the hose shown in **FIG. 3**, lateral edges of the soft spiral member **20** are fixed to the outer surfaces of the flanges **12** of the hard spiral member **10** while a central portion of the soft spiral member **20** is bent downward so that the lower surface of the soft spiral member **20** is level with the lower surface of the hard spiral member **10**. In this case, since the lower surface of the soft spiral member **20** is level with the lower surface of the hard spiral member **10**, the pressure of transferred water applied to the soft spiral member **20** can be reduced.

[0105] Further, as shown in **FIG. 4**, side edges of the soft spiral member **20** according to the present invention may be attached to inner surfaces of the flanges **12** of the hard spiral member **10** while the soft spiral member **20** is disposed in the spiral gap between the flanges **12**. In this case, it is preferred that the high-density polyethylene layer **28** forms the upper surface in contact with the inner surfaces of the flanges **12** of the hard spiral member **10**.

[0106] Further, in the case where side ends of the soft spiral member **20** made of the polyethylene tarpaulin are exposed to the inner surface of the hose, there may occur a sweating phenomenon, that is, water may leak through fine gaps between the texture of the woven polyethylene fabric layer **24** to the outside of the hose. Therefore, in order to prevent this sweating phenomenon, side ends of the polyethylene tarpaulin forming the soft spiral member **20** may be preferably coated with an adhesive or sealant material to form watertight ends **20*a***. As described above, in the case where side ends of the soft spiral member **20** exposed to the interior space of the spiral hose are formed as the watertight ends **20*a***, water is basically prevented from leaking through the woven polyethylene fabric layer **24**, thereby preventing

the sweating phenomenon, that is, preventing water from leaking out of the hose, even when a high pressure is formed in the spiral hose.

[0107] The watertight end **20***a* can be formed not only by coating the adhesive material on the side ends of the polyethylene tarpaulin forming the soft spiral member **20** as described above, but also by various other ways, for example, by folding the side ends of the polyethylene tarpaulin forming the soft spiral member **20** upward and then attaching them to the lower surfaces of the flanges **12** of the hard spiral member **10**, thereby preventing them from being exposed to the inner space of the hose.

[0108] Embodiment 2

[0109] **FIGS. 5 and 6** are sectional views of a main portion of a spiral hose according to another embodiment of the present invention, respectively. As shown, a hard spiral member **30** includes a convex section **34** which protrudes upward with angular corners to form a rectangular space in the convex section **34** and flanges **32** which extend laterally from lower ends of the convex section **34**. This construction enables the hard spiral member **30** to have a firmer construction, thereby preventing opposed inner surfaces of the hose from adhering to each other and enabling the shape of the hose to be maintained even when the pressure of the water transferred through the hose is very large.

[0110] In the case of the hard spiral member **30** having the above-mentioned construction-also, as shown in **FIGS. 5 and 6**, side edges of the soft spiral member **20** may be attached to either the inner surfaces or the outer surfaces of the flanges **32** of the hard spiral member **30**. In this case, it is preferred that the high-density polyethylene layer **28** of the soft spiral member **20** forms the surface attached to the flanges **32** of the hard spiral member **30**. Further, it is also preferred that, when the side edges of the soft spiral member **20** are attached to the inner surface of the hard spiral member **30**, side ends of the soft spiral member **20** are coated to be watertight, as in the previous embodiment.

[0111] **FIG. 7** is a sectional view showing another assembly between the hard spiral member **30** and the soft spiral member **20** according to another embodiment of the present invention, in which grooves are formed longitudinally along side portions of the lower surface of the hard spiral member **30** and side edges of the soft spiral member **20** are inserted in the grooves, so that side ends of the soft spiral member **20** are sealed to be watertight.

[0112] Embodiment 3

[0113] **FIGS. 8 and 9** show a spiral hose according to another embodiment of the present invention, which is used as a watering hose having spray holes.

[0114] That is, the soft spiral member **20** is formed by coating a woven polyethylene fabric layer **23** with polyethylene coating layers **21**, **25**, and **27**, each of which has a plurality of spray holes **21***a*, the polyethylene coating layer **25***a*, and the polyethylene coating layer **27***a*. In this case, water can be exhausted out of or introduced into the spiral hose through the gaps between the wefts and warps of the woven polyethylene fabric layer and through the spray holes **21***a*, **25***a*, and **27***a* formed through each of the polyethylene coating layers, so that the spiral hose can function as a watering hose.

[0115] Although the above description is given to the case where the spiral hose according to the present invention is used as a hose through which water is transferred, the spiral hose according to the present invention can be utilized also as a duct through which gas passes. In the latter case, in consideration that the duct may be installed while being bent more than 90°, it is preferred that each interval between wefts and between warps has a wide distance of 5 to 20 mm so that the soft spiral member **20** formed of the polyethylene tarpaulin has a high flexibility along with at least necessary strength.

[0116] Embodiment 4

[0117] Further, although each of the spiral hoses according to the embodiments described above has flanges formed at side edges of the hard spiral member, **FIG. 10** shows another embodiment of the present invention, in which a hard spiral member **40** has a hollow polygonal section without the flanges and side edges of the soft spiral member **20** may be attached to side portions of the lower surface of the hard spiral member **40**. Besides this, various modifications may be employed, for example, the hard spiral member **40** may have a solid polygonal section instead of the hollow polygonal section.

[0118] Meanwhile, in the spiral hose described above, in which the soft spiral member is attached to the inner surface of the hard spiral member, a separate labor of coating side ends of the soft spiral member for achieving water-tightness of the side ends thereof is indispensable, and the pressure of fluid flowing inside of the spiral hose or the shaking of the spiral hose itself may separate the hard spiral member and the soft spiral member from each other.

[0119] Further, in the case where the soft spiral member is attached to the outer surface of the hard spiral member also, in consideration of the characteristics of the spiral hose that it may be frequently deformed at various angles, the hard spiral member and the soft spiral member may be still separated from each other. Embodiments capable of overcoming these disadvantages will be described hereinafter.

[0120] Embodiment 5

[0121] **FIG. 11** is a perspective view of a spiral hose utilizing polyethylene according to another embodiment of the present invention, and **FIG. 12** is a sectional view of a portion of the spiral hose shown in **FIG. 11**. As shown, the spiral hose according to the present embodiment includes not only the hard spiral member **30** and the soft spiral member **20** attached together but also a fastening band **70** strengthening attachment between the hard spiral member **30** and the soft spiral member **20**.

[0122] That is, the hard spiral member **30** is made from polyethylene and extends in a shape of a coil spring with a spiral gap having a uniform width between turns of the coil spring. Further, in a sectional view in **FIG. 12**, the hard spiral member **30** includes a flat base section **32***a*, the convex section **34** which protrudes upward from the base section **32***a* with angular corners while forming a closed space in the convex section **34**, and the flanges **32** extending laterally from side ends of the base section **32***a*.

[0123] The soft spiral member **20** has a shape of a band and is made of polyethylene tarpaulin. The soft spiral member **20** is disposed along the spiral gap between turns of

the hard spiral member **30**, while lateral edges of the soft spiral member **20** are fixed to the flanges **32** disposed oppositely on both sides of the spiral gap. In other words, the hard spiral member **30** and the soft spiral member **20** each extending in a spiral shape are attached to each other in the way described above, thereby forming the spiral hose according to the present invention.

[0124] In a spiral hose according to the present invention, the polyethylene tarpaulin, the material of the soft spiral member **20**, may be a common tarpaulin formed by coating a low-density polyethylene layer **22** or **26** on at least one surface of the woven polyethylene fabric layer **24**. However, in the case where the spiral hose is made of the polyethylene tarpaulin formed by coating only the low-density polyethylene layer **22** or **26** on the woven polyethylene fabric layer **24**, the coated low-density polyethylene layer **22** or **26** may be torn by the internal pressure of the spiral hose, so that the transferred water may leak through the gaps between wefts and warps of the woven polyethylene fabric layer **24**. Therefore, it is preferred that the soft spiral member **20** is made of a polyethylene tarpaulin formed by coating a low-density polyethylene layer **26** and a high-density polyethylene layer **28** in sequence on at least one surface of the woven polyethylene fabric layer **24**.

[0125] The high-density polyethylene layer **28** implies an ordinary high-density polyethylene tarpaulin having a density of about 0.941 to 0.965 g/cm^2 and a tensile strength of only 330 to 340 kg/cm^2, which is 2.5 times larger than that of the low-density polyethylene tarpaulin, thereby having nearly the same breaking point as that of the woven polyethylene fabric layer **24**, enough to endure the pressure of transferred water when the high-density polyethylene layer **28** has been coated on the woven polyethylene fabric layer **24**.

[0126] In coating the high-density polyethylene layer **28** as described above, the low-density polyethylene layer **26** having a low melting point is coated on one surface of the woven polyethylene fabric layer **24**, and then the high-density polyethylene layer **28** is coated on the other surface of the woven polyethylene fabric layer **24**. This is because, when the high-density polyethylene layer **28**, having as a high melting point as the woven polyethylene fabric layer **24** has, is coated directly on an outer surface of the woven polyethylene fabric layer **24**, the coated surface may come off instead of being in tight contact with the surface of the woven polyethylene fabric layer **24**.

[0127] Further, the fastening band **70** has a shape of a band and is made from resin. The fastening band **70** is attached onto and covers over both an exposed portion of the lower surface of the flange **32** of the hard spiral member **30** and side edges of the soft spiral member **20**. In this case, it is preferred that the fastening band **70** is made from soft resin such as soft polyethylene, thereby preventing the flexibility of the soft spiral member **20** from being deteriorated by the attached fastening band **70**.

[0128] In the spiral hose having the construction described above according to the present embodiment, in like manner as in the previous embodiments, the assembling construction between the hard spiral member **30** and the soft spiral member **20** enables the spiral hose to not only be light but also to have a high pressure and strong tensile strength and resistance-to-pressure. Moreover, the fastening band **70** tightly covering the exposed portion of the lower surface of the flange **32** and side edges of the soft spiral member **20** naturally seals the side ends of the soft spiral member **20**, thereby eliminating a separate labor of coating the side ends of the soft spiral member **20**. Also, the fastening band **70** increases the cohesive force between the hard spiral member **30** and the soft spiral member **20**, thereby efficiently preventing the hard spiral member **30** and the soft spiral member **20** from being separated from each other by internal pressure or shaking of the spiral hose itself.

[0129] **FIG. 13** is an enlarged sectional view of a portion of a spiral hose utilizing polyethylene according to another embodiment of the present invention, in which a fastening band **72** is attached on each joint portion between the flanges **32** of the hard spiral member **30** and side edges of the hard spiral member **30**.

[0130] Embodiment 6

[0131] **FIG. 14** is an enlarged sectional view of a portion of a spiral hose utilizing polyethylene according to another embodiment of the present invention, which shows fastening bands **74** and **76** for reinforcing the attachment between the flanges **12** of the hard spiral member **10** and side edges of the soft spiral member **20** fused to and attached on the flanges **12**. In the drawing, reference numeral **14** designates a convex section forming a external shape of the spiral hose.

[0132] That is, in the case where the soft spiral member **20** is attached to the upper surface of the flanges **12** of the hard spiral member **10** as described above, the fastening band **74** may be attached in such a manner that the fastening band **74** covers over lower portions of side wall surfaces of the hard spiral member **10** and side edges of the soft spiral member **20**, and the fastening band **76** may be attached in such a manner that the fastening band **76** covers over both the flanges **12** of the hard spiral member **10** and the soft spiral member **20** attached to the upper surfaces of the flanges **12** of the hard spiral member **10**. Of course, the spiral hose according to the present invention may employ both of or one selected from among the fastening bands **74** and **76**.

[0133] Embodiment 7

[0134] Although each of the spiral hoses according to the embodiments described above has flanges formed at side edges of the hard spiral member, **FIG. 15** shows a portion of a spiral hose according to another embodiment of the present invention, in which the hard spiral member **40** has a hollow polygonal section without the flanges and side edges of the soft spiral member **20** may be attached to side portions of the lower surface of the hard spiral member **40**.

[0135] That is, in the spiral hose having the construction described above, a fastening band **80** may be attached in such a manner that the fastening band **80** covers over not only side edges of the soft spiral member **20** attached to side edges of the lower surface of the hard spiral member **40** but also a remaining portion of the lower surface of the hard spiral member **40**, and/or a fastening band **82** may be attached in such a manner that the fastening band **82** covers over lower portions of side wall surfaces of the hard spiral member **40** and side edges of the soft spiral member **20**.

[0136] Meanwhile, the construction as described above may be employed in a polyethylene spiral hose utilized as a gas duct or sewage pipe. In this case, in consideration that

the duct or sewage pipe may be installed while being bent more than 90°, it is preferred that each interval between wefts and between warps has a wide distance of 5 to 20 mm so that the polyethylene tarpaulin forming the soft spiral member **20** has a high flexibility along with at least necessary strength.

[0137] In the meantime, in order to prevent the spiral hose as described above from being broken in the cold winter season, the spiral hose should be wrapped by a heat insulation coat. However, the spiral and flexural shape of the outer surface of the spiral hose causes the labor of wrapping the heat insulation coat around the spiral hose to be difficult and time-consuming. Further, according to passage of time, the heat insulation coat wrapped around the spiral hose may be loosened or even partially separated from the spiral hose, so that it is difficult to anticipate the heat insulation coat having a long-term continuous heat insulation effect and, furthermore, the external appearance of the spiral hose may look messy, thereby requiring the heat insulation coat to be frequently replaced. Hereinafter, embodiments for overcoming such disadvantages will be described.

[0138] Embodiment 8

[0139] **FIG. 16** is a perspective view of a spiral hose utilizing polyethylene according to another embodiment of the present invention, and **FIG. 17** is a sectional view of a portion of the spiral hose shown in **FIG. 16**. As shown, the spiral hose according to the present embodiment includes not only the hard spiral member **30** and the soft spiral member **20** attached together but also a heat-insulation foam **90** for keeping the spiral hose warm.

[0140] That is, the hard spiral member **30** is made from hard resin and extends in a shape of a coil spring with a spiral gap having a uniform width between turns of the coil spring. Further, in a sectional view of **FIG. 17**, the hard spiral member **30** includes a flat base section **32*a***, the convex section **34** which protrudes upward from the base section **32*a*** with angular corners while forming a closed space in the convex section **34**, and the flanges **32** extending laterally from side ends of the base section **32*a***.

[0141] The soft spiral member **20** has a shape of a band made of resin. The soft spiral member **20** is disposed along the spiral gap between turns of the hard spiral member **30**, while lateral edges of the soft spiral member **20** are fixed to the flanges **32** disposed oppositely on both sides of the spiral gap. In other words, the hard spiral member **30** and the soft spiral member **20** each extending in a spiral shape are attached to each other in the way described above, thereby forming a spiral hose having a spiral groove according to the present invention.

[0142] Further, the heat-insulation foam **90** is filled in the spiral groove formed on the outer surface of the spiral hose and fixed to the upper surface of the soft spiral member **20**, thereby insulating and warming the spiral hose.

[0143] The spiral hose having the construction described above according to the present embodiment necessarily has a high tensile strength and flexibility and a strong resistance-to-pressure as do the spiral hoses according to the previous embodiments. Moreover, in the spiral hose, the thick hard spiral member **30** has an adiabatic characteristic due to its own thickness while the thin soft spiral member **20** having no adiabatic characteristic is insulated from heat by the foam **90** attached onto the soft spiral member **20**, so as to prevent heat from being transferred between the interior and exterior of the spiral hose, thereby enabling the spiral hose to have an excellent heat-keeping effect.

[0144] In addition, in the spiral hose having the construction described above, the foam **90** is integrally fixed in the spiral groove formed on the soft spiral member **20**. Therefore, the foam **90** is not loosened or separated from the soft spiral member **20** even when the spiral hose has been used for long time, and the external appearance of the spiral hose can be always maintained clean and tidy, thereby largely increasing the marketability of the spiral hose.

[0145] Meanwhile, a Biaxially Oriented Polypropylene (BOPP) film, a Polyethylene Terephthalate (PET) film, or a high-density Polyethylene (HDPE) film may be utilized as the hard spiral member **30**. Especially, the HDPE film implies an ordinary high-density polyethylene film having a density of about 0.941 to 0.965 g/cm^2 and a tensile strength of only 330 to 340 kg/cm^2, which is 2.5 times larger than that of the low-density polyethylene (LDPE) film, thereby having nearly the same breaking point as that of the woven polyethylene fabric layer **24**, which enables the spiral hose to effectively maintain its shape.

[0146] In the spiral hose described above, the soft spiral member may employ a low-density polyethylene (LDPE) film, a casting polypropylene (CPP) film, a thermoplastic elastomer, a polyethylene tarpaulin, or silicon, which can provide the spiral hose with flexibility. Especially, the polyethylene tarpaulin is formed by coating LDPE and/or HDPE on at least one surface of a woven polyethylene fabric and has a very high breaking point in comparison with its thickness, so that the polyethylene tarpaulin can be preferably used in manufacturing a high-pressure hose. **FIG. 16** shows a soft spiral member **20** made of a polyethylene tarpaulin formed by laminating the low-density polyethylene layer **22**, the woven polyethylene fabric layer **24**, the low-density polyethylene layer **26**, and the high-density polyethylene layer **28**, in sequence upward from the bottom of the soft spiral member **20**.

[0147] In the spiral hose described above, which includes the hard spiral member **30** made from HDPE, the soft spiral member **20** made from polyethylene tarpaulin, and the foam **90** made from polyethylene foam, a strong cohesive force between the hard spiral member **30**, the soft spiral member **20**, and the foam **90** can be obtained due to the same material being used in all of them.

[0148] Meanwhile, in the spiral hose having the construction described above, the fastening band **70** may be so attached as to cover over both an exposed portion of the lower surface of the flange **32** of the hard spiral member **30** and side edges of the soft spiral member **20**, thereby water-tightly sealing side ends of the soft spiral member **20** and increasing the cohesive force between the hard spiral member **30** and the soft spiral member **20**. In this case, it is preferred that the fastening band **70** is made from soft resin such as soft polyethylene, thereby preventing the flexibility of the soft spiral member **20** from being deteriorated by the attached fastening band **70**.

[0149] Further, an aluminum foil **95** usually utilized as an adiabatic or heat-insulating material may be attached, in a spiral shape, along and to the upper surface of the foam **90**

fixed to the upper surface of the soft spiral member **20** of the spiral hose, thereby further improving the adiabatic or heat-insulating function of the spiral hose.

[0150] FIGS. **17** to **19** show various examples of attachment between heat-insulation foams **90** to **92** and aluminum foils **95** to **97**. In the spiral hose shown in **FIG. 17**, a heat-insulation foam **90** and an aluminum foil **95** are sequentially attached in the groove formed on the soft spiral member **20**. In the spiral hose shown in **FIG. 18**, a heat-insulation foam **91** is completely filled in the groove on the soft spiral member **20**, and an aluminum foil **96** is so attached as to completely cover the upper surfaces of the hard spiral member **30** and the foam **91** while extending in a spiral shape. Further, in the spiral hose shown in **FIG. 19**, a heat-insulation foam **92** is not only completely filled in the groove with the soft spiral member **20** but also covers over the hard spiral member **30**, and the aluminum foil **96** is so attached as to completely cover the upper surface of the foam **92** while extending in a spiral shape, thereby completely covering the outer surface of the spiral hose.

[0151] Embodiment 9

[0152] **FIGS. 20 and 21** show spiral hoses according to other embodiments of the present invention, in which an aluminum foil **98** is attached to one surface of the soft spiral member **20** attached to side edges of an inner surface of the hard spiral member **30** along a spiral gap formed between turns of the hard spiral member **30**. That is, the aluminum foil **98** may be attached to an outer surface and/or an inner surface of the soft spiral member **20**, so that the soft spiral member **20**, which has a weak adiabatic function, can be insulated from heat doubly by the foam **90** and the aluminum foil **98**, thereby improving the heat-keeping capability of the spiral hose.

[0153] **FIG. 22** shows a spiral hose according to other embodiments of the present invention, in which an aluminum foil **99** is first attached to an upper surface of the soft spiral member **20** and the foam **90** is then attached to an upper surface of the aluminum foil **99**. In the spiral hose having the construction described above also, the soft spiral member **20**, which has a weak adiabatic function, can be insulated from heat doubly by the foam **90** and the aluminum foil **99**, thereby improving the heat-keeping capability of the entire spiral hose.

[0154] In the spiral hose described above, the soft spiral member having a lower strength may be easily depressed toward the inner space of the spiral hose by an external force. Especially, when the spiral hose described above is used as a suction hose, the pressure of sucked fluid may repeatedly fold and unfold the soft spiral member and repeatedly suck and separate the spaced turning portions of the hard spiral member to and from each other, so that the spiral hose may violently shake while repeatedly contracting and expanding and may frequently escape its originally installed position. This shaking of the spiral hose may apply repetitive impact to attachment portions between the hard and soft spiral members and scratch the surface of the spiral hose, thereby shortening the lifespan of the spiral hose.

[0155] Further, when the spiral hose having the hollow hard spiral member is used as a sewage pipe, the hollow hard spiral member may also be pressed and deformed to decrease the sectional area of the spiral hose, thereby weakening the strength of the sewage pipe. In the worse case, the deformed hard spiral member may be depressed inward of the spiral hose, thereby decreasing the draining function of the hose. Spiral hoses according to other embodiments of the present invention in order to overcome these disadvantages will be described hereinafter.

[0156] Embodiment 10

[0157] **FIG. 23** is a perspective view of a spiral hose utilizing polyethylene according to another embodiment of the present invention, and **FIG. 24** is a sectional view of a portion of the spiral hose shown in **FIG. 23**. As shown, the spiral hose according to the present embodiment includes the hard spiral member **10**, the soft spiral member **20**, and a reinforcement member.

[0158] The hard spiral member **10** is made from hard resin and extends in a shape of a coil spring which has a spiral gap having a uniform width between turns of the coil spring. In its sectional view, the hard spiral member **10** includes the convex section **14** protruding upward (that is, outward from the body of the spiral hose) with angular corners and the flanges **12** extending laterally from lower ends of the convex section **14**.

[0159] The soft spiral member **20** has a shape of a band made of resin. The soft spiral member **20** is disposed along the spiral gap between turns of the hard spiral member **10**, while lateral edges of the soft spiral member **20** are fixed to the flanges **12** disposed at both sides of the spiral gap and opposed to each other. In other words, the hard spiral member **10** and the soft spiral member **20** each extending in a spiral shape are attached to each other in the way described above, thereby forming a spiral hose having a spiral groove according to the present invention.

[0160] Further, the reinforcement member is a member made from soft material, which maintains uniform turning pitches of the hard spiral member **10** in the longitudinal direction of the spiral hose. The reinforcement member is disposed above the soft spiral member **20** and side edges of the reinforcement member are attached to adjacent side portions of the upper surface of the hard spiral member **10** through a way of thermal fusion or the like.

[0161] In the spiral hose having the construction described above, the reinforcement member is disposed above the soft spiral member **20** while continuously connecting adjacent side portions of the upper surface of the hard spiral member **10**, so as to reinforce the strength of the soft spiral member **20**, thereby preventing the soft spiral member **20** from being depressed toward the inner space of the spiral hose by an external force. Further, the reinforcement member firmly maintains the spacings between the turns of the hard spiral member **10**, so as to prevent the hose from contracting and expanding in the longitudinal direction of the hose even when liquid is sucked through the hose, thereby preventing the hose from escaping its original position and preventing it from being scratched, and also thereby largely improving the durability of the hose.

[0162] Meanwhile, a Biaxially Oriented Polypropylene (BOPP) film, a Polyethylene Terephthalate (PET) film, or a high-density Polyethylene (HDPE) film may be utilized as the hard spiral member **10**. Especially, the HDPE film implies an ordinary high-density polyethylene film having a density of about 0.941 to 0.965 g/cm^2 and a tensile strength

of only 330 to 340 kg/cm^2, which is 2.5 times larger than that of the low-density polyethylene (LDPE) film, thereby having nearly the same breaking point as that of the woven polyethylene fabric layer **24**, which enables the spiral hose to effectively maintain its shape.

[0163] The soft spiral member **20** is a means for providing the spiral hose with flexibility. A low-density polyethylene (LDPE) film, a casting polypropylene (CPP) film, a thermoplastic elastomer, a polyethylene tarpaulin, or silicon may be employed as the soft spiral member **20**. Especially, when the hard spiral member **10** is formed of a single layer of HDPE, it is preferred that the soft spiral member **20** is formed of a single layer of polyethylene tarpaulin or laminated multi-layers of soft polyethylene/polyethylene tarpaulin.

[0164] The polyethylene tarpaulin is formed by coating LDPE and/or HDPE on at least one surface of a woven polyethylene fabric and has a very high breaking point in comparison with its thickness, so that the polyethylene tarpaulin can be preferably used in manufacturing a high-pressure hose. **FIG. 23** shows a soft spiral member **20** made of a polyethylene tarpaulin formed by laminating the low-density polyethylene layer **22**, the woven polyethylene fabric layer **24**, the low-density polyethylene layer **26**, and the high-density polyethylene layer **28** in sequence upward from the bottom of the soft spiral member **20**.

[0165] In the spiral hose described above, which includes the hard spiral member **10** made from HDPE, the soft spiral member **20** made from polyethylene tarpaulin and/or soft polyethylene, and a reinforcement member made from polyethylene, strong cohesive force between the hard spiral member **10**, the soft spiral member **20**, and the reinforcement member can be obtained due to the same material being used in all of them.

[0166] Meanwhile, in the spiral hose having the construction described above, the reinforcement member may be a flexure cover **110** or **112**, which is disposed above the soft spiral member **20** while its side edges are attached to adjacent side portions of the upper surface of the hard spiral member **10** and its central portion in the transverse direction is concave downward, as shown in **FIG. 24** and the polyethylene coating layer **25**. In this case, the central portion of the flexure cover **110** or **112** in its transverse direction may be smoothly curved downward as shown in **FIG. 24** or sharply bent downward as shown in **FIG. 25**.

[0167] Embodiment 11

[0168] FIGS. **26** to **28** are partial sectional views of spiral hoses according to other embodiments of the present invention, each of which includes a hollow hard spiral member **30** and a soft spiral member **20** assembled together, and a reinforcement member attached to the assembled hard and soft spiral members **30** and **20**.

[0169] That is, a flexure cover **114**, **116**, or **118** is disposed above and along the soft spiral member **20**. Side edges of the flexure cover **114**, the flexure cover **116**, or the flexure cover **118** are attached to side portions of an upper surface of the hard spiral member **30** disposed at either side of the soft spiral member **20**, and a central portion of the flexure cover **114**, the flexure cover **116**, or the flexure cover **118** is depressed downward and fixed to the upper surface of the soft spiral member **20**.

[0170] In **FIG. 26**, the flexure cover **114** is dully curved downward in its transverse sectional view and has a relatively wide central portion attached to the upper surface of the soft spiral member **20**. In **FIG. 27**, the flexure cover **116** is depressed downward while being bent twice with sharp corners in its transverse sectional view, and has a relatively wide central portion attached to the upper surface of the soft spiral member **20**. In **FIG. 28**, the flexure cover **118** is depressed downward while being bent once with a sharp corner in its transverse sectional view, which is a sharp central point attached to the upper surface of the soft spiral member **20**.

[0171] Embodiment 12

[0172] FIGS. **29** to **31** are partial sectional views of spiral hoses according to other embodiments of the present invention, each of which includes a hollow hard spiral member **30**, a soft spiral member **20** attached to side edges of a lower surface of the hard spiral member **30**, and a reinforcement member assembled between the hard spiral member **30** and the soft spiral member **20**.

[0173] That is, the flexure cover **120**, **122**, or **124** is disposed above and along the soft spiral member **20**. Side edges of the flexure cover **120**, **122**, or **124** are attached to side portions of a lower surface of the hard spiral member **30** disposed at either side of the soft spiral member **20**, and a central portion of the flexure cover **120**, **122**, or **124** is curved upward to form a bulging portion.

[0174] In **FIG. 29**, the flexure cover **120** has a central bulging portion dully curved upward in its transverse sectional view. In **FIG. 30**, the flexure cover **122** has a central bulging portion bent twice with sharp corners in its transverse sectional view, which thereby has a relatively wide central portion. In **FIG. 31**, the flexure cover **124** has a central bulging portion bent once with a sharp corner in its transverse sectional view, which thereby has a sharp central point.

[0175] Embodiment 13

[0176] **FIGS. 32 and 33** are partial sectional views of spiral hoses according to other embodiments of the present invention, each of which includes a hollow hard spiral member **30** and a soft spiral member **20** assembled together, and a reinforcement member attached to the assembled the hard and soft spiral members **30** and **20**. The reinforcement member may be a flexure cover **126** which has a central bulging portion dully curved upward and side edges fixed to side portions of the exposed upper surface of the soft spiral member **20** as shown in its transverse sectional view of **FIG. 32**, or a flexure cover **128** which has a central upward bulging portion bent once with a sharp corner and side edges fixed to lower portions of the side walls of the hard spiral member **40** as shown in its transverse sectional view of **FIG. 33**.

[0177] Embodiment 14

[0178] **FIG. 34** is a perspective view of a spiral hose utilizing polyethylene according to another embodiment of the present invention, which includes a hollow hard spiral member **30** and a soft spiral member **20** assembled together, and a hollow flexible member **130** which is another type of a reinforcement member.

[0179] The hollow flexible member **130** has a flexible member having a hollow shape in its side-sectional view, which is disposed in and along the spiral groove formed on the soft spiral member **20**. Outer side portions of the hollow flexible member **130** are attached to adjacent outer side surfaces of the hard spiral member **40**. It is preferred that the hollow flexible member **130** is made from soft resin so as to prevent flexibility and bendability of the soft spiral member **20** from deteriorating due to the hollow flexible member **130**. Further, not only the outer side portions of the hollow flexible member **130** are attached to adjacent outer side surfaces of the hard spiral member **40**, but an outer lower portion of the hollow flexible member **130** may also be attached to an upper surface of the soft spiral member **20**, so as to further increase the attachment security of the hollow flexible member **130**.

[0180] In this construction, the hollow flexible member **130** having the hollow construction elastically maintains the gaps between the turns of the hard spiral member **40**, thereby not only improving the strength of the soft spiral member **20** but also enabling the spiral hose to more effectively contract and expand.

[0181] In the case where the hollow flexible member **130** is disposed along the spiral gap formed above the soft spiral member **20**, alien material may be squeezed between the hollow flexible member **130** and the hard spiral member **40**, deteriorating the flexibility of the spiral hose. Therefore, it is preferred that a protection cover **150** is attached on the hollow flexible member **130** to prevent alien material from being introduced into the gap between the hollow flexible member **130** and the hard spiral member **40**, thereby preventing the flexibility of the spiral hose from deteriorating due to the introduction of the alien material.

[0182] In this case, in order to prevent the flexibility of the spiral hose from being caused to deteriorate by the protection cover **150**, the protection cover **150** should be made from soft resin, and the protection cover **150** may employ a single layer structure made from polyethylene tarpaulin or soft polyethylene having a good flexibility or may employ a laminated multi-layer structure made from soft polyethylene/polyethylene tarpaulin. Further, the protection cover **150** may be so wound in a spiral shape as to cover only the hollow flexible member **130** in the spiral groove, or as to cover both the hollow flexible member **130** and the hard spiral member **40**. In the latter case, external appearance of the spiral hose can be improved and a tighter assembling force can be provided between the soft and hard spiral members.

[0183] Embodiment 15

[0184] **FIG. 35** is a partial sectional view of a spiral hose according to another embodiment of the present invention, which includes a hollow hard spiral member **50** and a soft spiral member **20** assembled together, and a flexible lamination **140** which is another type of a reinforcement member. The flexible lamination **140** is fixed to an upper surface of the soft spiral member **20** and filled in a spiral groove between turns of the hard spiral member **50**.

[0185] The flexible lamination **140** tightly attached to the upper surface of the soft spiral member **20** improves the strength of the soft spiral member **20** itself and prevents the soft spiral member **20** from being folded to thereby maintain the uniformity of the gaps between turns of the hard spiral member **50**. It is preferred that the flexible lamination **140** is made from soft polyethylene having good flexibility and adhesion.

[0186] Especially, the flexible lamination **140** is more useful in the structure shown in **FIG. 35**, in which the hard spiral member **50** and the soft spiral member **20** are attached to each other while the side surface of the hard spiral member **50** makes an acute angle with respect to the upper surface of the soft spiral member **20**, than in the structure in which the side surface of the hard spiral member **50** makes a right angle with respect to the upper surface of the soft spiral member **20**, because a wider contact surface can be formed between the flexible lamination **140** and the hard spiral member **50** by the same amount of soft polyethylene to thereby increase adhesion and cohesive force in the former structure than in the latter structure.

[0187] Embodiment 16

[0188] Further, a hole **141** may be formed through a central portion of each turn of the flexible lamination **140** in its sectional view of **FIG. 35**, so as to increase the flexibility of the soft spiral member **20**. Or, a reinforcement core **142** may be inserted through a hole formed through a central portion of each turn of the flexible lamination **140** in its sectional view of **FIG. 36**, so as to increase the strength of the soft spiral member **20**. These holes **141** or the reinforcement cores **142** may be formed or not according to the use of the spiral hose. Further, when the flexible lamination **140** is made from soft polyethylene, the reinforcement core **142** may preferably be made from high-density polyethylene which is the same material as that of the flexible lamination **140**, so as to achieve a stronger cohesive force.

[0189] Further, it is preferred that a soft cover **160** having a shape of a band is attached to an upper end of a spiral groove above the flexible lamination **140** to close the inside of the spiral groove, thereby preventing alien material from coming into the spiral groove and thus the flexibility of the spiral hose from deteriorating. In this case, both lateral sides of the soft cover **160** having a band shape may be attached to upper portions of the hard spiral member **10**. The soft cover **160** may employ a single layer structure made from polyethylene tarpaulin or soft polyethylene having a good flexibility or may employ a laminated multi-layer structure made from soft polyethylene/polyethylene tarpaulin.

[0190] Further, in a spiral hose according to the present invention, when the hard spiral member **50** has a hollow sectional shape, it is more preferable that a reinforcement piece **100** is disposed across the center of the hard spiral member **50** along the entire length of the hard spiral member **50**, so as to reinforce the strength of the hard spiral member **50** in its inner and outer directions.

[0191] **FIG. 37** is a partial sectional view of a spiral hose according to another embodiment of the present invention, which includes a hard spiral member **60** having a hexagonal sectional shape, the soft spiral member **20**, the flexible lamination **140**, the reinforcement core **142**, the soft cover **160**, and a reinforcement piece **102**, which are assembled together. The function and effect of the spiral hose shown in **FIG. 37** are the same as those of the spiral hose shown in **FIG. 36**.

[0192] The following description regarding embodiments 17 to the soft spiral member **20** relates to watering hoses utilizing polyethylene.

[0193] Embodiment 17

[0194] A watering hose such as that described in embodiment 3 requires various complicated and precise manufacturing steps which include: forming the spray holes **22*a*, 26*a***, and **28*a*** through a plurality of polyethylene sheets **22, 26**, and **28**; and fusing the polyethylene sheets **22, 26**, and **28** together with the woven polyethylene fabric layer **24** to each other after aligning the spray holes **22*a*, 26*a***, and **28*a*** to each other. Further, when the spray holes **22*a*, 26*a***, and **28*a*** are exactly aligned to each other and fusion is performed, a manufactured hose may not function as a spiral hose.

[0195] **FIG. 38** is a perspective view of a watering hose utilizing polyethylene according to another embodiment of the present invention, and **FIG. 39** is a partial sectional view of **FIG. 39**. As shown, the watering hose includes the hard spiral member **10** and the soft spiral member **20S** assembled together.

[0196] The hard spiral member **10** is made from polyethylene and extends in a shape of a coil spring with a spiral gap having a uniform width between turns of the coil spring. In its sectional view, the hard spiral member **10** includes the convex section **14** which protrudes upward with angular corners and the flanges **12** which extend laterally from lower ends of the convex section **14**.

[0197] Further, the soft spiral member **20S** has a shape of a band and is made of woven polyethylene fabrics. The soft spiral member **20S** is disposed along the spiral gap between turns of the hard spiral member **10**, while lateral edges of the soft spiral member **20S** are fixed to the flanges **12** disposed oppositely on both sides of the spiral gap. In other words, the hard spiral member **10** and the soft spiral member **20S** each extending in a spiral shape are attached to each other in the way described above, thereby forming the watering hose according to the present invention. In this case, it is preferred that the spiral gap between the turns of the hard spiral member **10** has a width of 1.5 to 3.0 cm, so as to prevent the watering hose from being twisted due to the soft spiral member **20S**.

[0198] In this construction, the hard spiral member **10** made from polyethylene is bent and protrudes outward to form a space inside thereof, so that opposed inner surfaces of the spiral hose are not adhered to each other but the spiral hose can maintain its original shape even when a strong suction pressure is formed in the spiral hose. Further, in the spiral hose, the soft spiral member **20S** disposed in the gap between turns of the hard spiral member **10** is made of woven polyethylene fabrics having a high tensile strength and flexibility even with a small thickness, so that the watering hose can sufficiently endure a strong pressure by water, etc., sucked by a pump. Further, the watering hose having the construction described above, in which the soft spiral member **20S** is only formed of woven polyethylene fabrics, has a lower production cost and simpler manufacturing process, thereby highly improving the productivity, in comparison with a spiral hose having a soft spiral member made of polyethylene tarpaulin.

[0199] Meanwhile, it is preferred that each interval between wefts and between warps of the woven polyethylene fabrics has a wide distance of 5 to 20 mm so that the soft spiral member **20S** formed of the woven polyethylene fabrics has a high flexibility along with at least necessary strength.

[0200] In a watering hose shown in **FIG. 40**, lateral edges of the soft spiral member **20S** are fixed to the outer surfaces of the flanges **12** of the hard spiral member **10** as are in **FIG. 39**, while a central portion of the soft spiral member **20S** is bent downward so that the lower surface of the soft spiral member **20S** is level with the lower surface of the hard spiral member **10**. In this case, since the lower surface of the soft spiral member **20S** is level with the lower surface of the hard spiral member **10**, the pressure of transferred water applied to the soft spiral member **20S** can be reduced.

[0201] Further, as shown in **FIG. 41**, side edges of the soft spiral member **20S** according to the present invention may be attached to inner surfaces of the flanges **12** of the hard spiral member **10** while the soft spiral member **20S** is disposed in the spiral gap between the flanges **12**.

[0202] Embodiment 18

[0203] **FIGS. 42 and 43** are partial sectional views of watering hoses according to other embodiments of the present invention. As shown, the hard spiral member **30** includes a base section **32*a***, a convex section **34** which protrudes upward from the base section **32*a*** with angular corners to form a rectangular space therein, and flanges **32** which extend laterally from the base section **32*a***. In this case, both side edges of the soft spiral member **20S** may be attached to either inner surfaces or outer surfaces of the flanges **32**.

[0204] This construction enables the hard spiral member **30** to have a closed space therein, thereby enabling the watering hose to more firmly keep its shape.

[0205] **FIG. 44** is a sectional view showing another assembly between the hard spiral member **30** and the soft spiral member **20S** according to another embodiment of the present invention, in which grooves are formed longitudinally along side portions of the lower surface of the hard spiral member **30** and side edges of the soft spiral member **20S** are inserted in the grooves, so that the side ends of the soft spiral member **20S** are then sealed to be watertight and the hard spiral member **30** and the soft spiral member **20S** can be more firmly assembled together.

[0206] Embodiment 19

[0207] **FIG. 45** is a partial sectional view of a watering hose utilizing polyethylene according to another embodiment of the present invention, in which the hard spiral member **40** has a hollow polygonal section without the flanges and side edges of the soft spiral member **20S** made from woven polyethylene fabrics may be attached to side portions of the lower surfaces of the hard spiral member **40**.

[0208] Embodiment 20

[0209] **FIG. 46** is a perspective view of a watering hose utilizing polyethylene according to another embodiment of the present invention, and **FIG. 47** is a partial sectional view of the watering hose shown in **FIG. 46**. As shown, the watering hose according to the present embodiment includes not only the hard spiral member **30** and the soft spiral

member 20S attached together but also the fastening band 70 having a shape of a band made from soft polyethylene.

[0210] That is, the fastening band 70 having a shape of a band made from soft polyethylene is attached to an exposed portion of a lower surface of the base section 32*a* and side portions of the soft spiral member 20S disposed at both sides of the exposed portion. Reference numerals not described in this embodiment designate the same elements as those in the embodiment shown in **FIG. 43**.

[0211] In this construction, since a central portion of the fastening band 70 made from soft polyethylene film is tightly attached to the exposed portion of the lower surface of the base section 32*a* and side portions of the fastening band 70 are tightly attached to the side portions of the soft spiral member 20S disposed at both sides of the exposed portion, the attachment portions between the soft spiral member 20S and the hard spiral member 30 are compressed so as to largely improve the durability of the watering hose.

[0212] **FIG. 48** is a perspective view of a watering hose according to another embodiment of the present invention, and **FIG. 49** is a sectional view taken along line A-A in **FIG. 48**. As shown, the watering hose according to the present embodiment further includes a coated film 20*c* formed on a lower portion of the inner surface of the watering hose having the construction shown in **FIG. 38**. That is, the coated film 20*c* is formed on the lower portion of the inner surface of the watering hose having the hard spiral member 10 and the soft spiral member 20S, so as to block gaps formed through a lower portion of the woven polyethylene fabrics from among the soft spiral member 20S.

[0213] In this construction, fluid is prevented from being discharged through the lower gaps through a lower portion of the spiral hose, so that fluid having been introduced through upper gaps of the spiral hose can be safely carried up to a desired destination. Further, a coated film 20*b* may be interposed between the hard spiral member 10 and the soft spiral member 20S as shown in **FIG. 50**.

[0214] It is preferred that the coated films 20*b* and 20*c* are made from low-density polyethylene having a good flexibility, since they need not endure pressure of the fluid but have only a function of blocking the gaps through the woven polyethylene fabrics.

[0215] In addition to the various spiral hoses utilizing polyethylene according to various embodiments of the present invention as described above, the following embodiments 21 and 22 show other several spiral hoses having spiral flexure portions, which have attachment portions with increased attachment force and can be manufactured by a simplified process, thereby improving productivity.

[0216] Embodiment 21

[0217] In the spiral hoses utilizing polyethylene as described above, soft and hard spiral members are attached to each other by heat fusion while extending in a spiral shape, respectively. Therefore, the manufacturing process of the spiral hose is very complicated and difficult, so that the productivity is deteriorated. Further, when the hose severely shakes, the heat-fused attachment portion between the two members having different properties may be easily separated from each other.

[0218] **FIG. 51** is a perspective view of a spiral hose utilizing polyethylene according to another embodiment of the present invention. As shown, the spiral hose is formed of a single polyethylene member 200.

[0219] That is, the polyethylene member 200 is a member having a shape of a band which is bent to form a convex portion 202 and a concave portion 204 adjacent to each other in its sectional view. The polyethylene member 200 having this construction is wound in a coil shape to form the spiral hose. In this case, a plurality of the convex portions 202 and a plurality of the concave portions 204 are alternately engaged with and fused to each other, so as to form an integral spiral hose.

[0220] In the spiral hose having the construction described above, since the spiral hose is formed of the single band-shaped polyethylene member, the manufacturing process of the spiral hose can be simplified to highly improve the productivity. Further, the heat-fused portions are made from the same single material and thereby have a strong cohesive force, so that they are prevented from being separated from each other even when the spiral hose severely shakes.

[0221] It is preferred that the polyethylene member 200 is made from high-density polyethylene having a density of about 0.941 to 0.965 g/cm^2. The high-density polyethylene has a tensile strength of only 330 to 340 kg/cm^2, which is 2.5 times larger than that of the low-density polyethylene, thereby having nearly the same breaking point as that of the woven polyethylene fabrics, enough to endure the pressure of transferred water when the high-density polyethylene layer 28 has been coated on the woven polyethylene fabric layer 24.

[0222] In an enlarged view in **FIG. 51**, the polyethylene member 200 has a shape like a laid "S" in its side sectional view, so that the convex portion 202 and the concave portion 204 can be assembled together to form a rectangular sectional shape.

[0223] Further, in the polyethylene member 200, side edges of a reinforcement band 220 may be attached to lower side ends of the concave portion 204 disposed at either side of the convex portion 202 so as to form a closed space inside of the convex portion 202.

[0224] In this construction, a continuous spiral space is formed inside of the spiral hose, so that the spiral hose can have an improved strength and the reinforcement band 220 can uniformly maintain the gap between the lower ends of the convex portion 202, thereby preventing the spiral hose from being deformed and improving the durability of the spiral hose.

[0225] Embodiment 22

[0226] **FIG. 52** is an enlarged partial sectional view of a spiral hose utilizing polyethylene according to another embodiment of the present invention.

[0227] As shown, a polyethylene member 210 according to the present invention includes a convex portion 212 and a concave portion 214 integrated with each other to form a shape like a sine wave in its sectional view. In this case, the polyethylene member 210 is wound in a coil shape, and end portions of the convex portion 212 and the concave portion 214 in contact with each other are then overlapped and heat-fused, so as to form the integral spiral hose.

[0228] Further, in the construction described above also, it is preferred that side ends of a reinforcement band 230 are continuously heat-fused to the lower end portions of the concave portion 214, to thereby increase the strength of the spiral hose, prevent the spiral hose from being deformed, and improve the durability of the spiral hose.

[0229] Meanwhile, the reinforcement band 220 and 230 may be made from polyethylene tarpaulin, soft polyethylene, or silicon. Polyethylene tarpaulin has a high tensile strength so as to highly increase the durability of the spiral hose. Soft polyethylene has a high flexibility to thereby enable ripple portions of two spiral hoses to be easily assembled with each other. Silicon, especially, not only has a high flexibility to thereby enable ripple portions of two spiral hoses to be easily assembled with each other, but also has a high surface smoothness to thereby reduce frictional resistance and a high melting point to thereby have a high thermal durability.

[0230] FIG. 53 is an enlarged partial sectional view of a spiral hose utilizing polyethylene according to another embodiment of the present invention, which includes a reinforcement band 230 formed of a soft polyethylene layer 232 and a polyethylene tarpaulin layer 234.

[0231] That is, the soft polyethylene layer 232 has a shape of a band extending with a uniform width, and the polyethylene tarpaulin layer 234 has a width smaller than that of the soft polyethylene layer 232. Therefore, the polyethylene tarpaulin layer 234 with a relatively smaller width is attached along a central portion of the soft polyethylene layer 232 in its transverse direction, so that edge portions of the soft polyethylene layer 232 in its transverse direction are exposed. Further, the exposed edge portions of the soft polyethylene layer 232 to which the polyethylene tarpaulin layer 234 is attached are continuously heat-fused to the lower surface of the concave portion 214 at either side of the convex portion 212.

[0232] In this construction, the exposed edge portions of the soft polyethylene layer 232 continuously heat-fused to the lower surface of the concave portion 214 at either side of the convex portion 212 form a continuous closed space inside of the convex portion 212, and the soft polyethylene layer 232 is strongly held by the polyethylene tarpaulin layer 234, so that the durability of the spiral hose can be highly improved.

[0233] In the construction as shown in FIG. 53, instead of the soft polyethylene layer 232, soft resin such as silicon may be utilized. Especially, the silicon has a high flexibility, a high surface smoothness, and a high melting point and thermal durability, to thereby enable ripple portions of two spiral hoses to be easily assembled with each other, to thereby reduce frictional resistance thereby minimizing shaking of the spiral hose even when fluid is carried with a high pressure, and to thereby prevent thermal deformation of the spiral hose.

[0234] FIG. 54 is an enlarged partial sectional view of a spiral hose utilizing polyethylene according to another embodiment of the present invention, which includes a reinforcement band 230 formed of a polyethylene tarpaulin layer 234 and a soft polyethylene layer 232.

[0235] That is, the soft polyethylene layer 232 has a shape of a band extending with a uniform width, and the polyethylene tarpaulin layer 234 has a width smaller than that of the soft polyethylene layer 232. Therefore, the polyethylene tarpaulin layer 234 with a relatively smaller width is attached along a side portion of the soft polyethylene layer 232 in its transverse direction, so that the other side portion of the soft polyethylene layer 232 in its transverse direction is exposed. In other words, the soft polyethylene layer 232 has an exposed and a covered side portion which are opposite to each other in the transverse direction of the soft polyethylene layer 232. In this case, the covered side portion signifies a transverse side portion covered by the polyethylene tarpaulin layer 234, and the exposed side portion signifies the other transverse side portion not covered by the polyethylene tarpaulin layer 234.

[0236] Further, at one side of the convex portion 212, the exposed side portion of the soft polyethylene layer 232 is attached to the lower surface of the concave portion 214, and the covered side portion of the soft polyethylene layer 232 is then attached to the lower surface of the exposed side portion of the soft polyethylene layer 232 attached to the lower surface of the concave portion 214.

[0237] By this construction, the spiral hose has advantages owing to the attachment between soft polyethylene and polyethylene tarpaulin as described in relation to the embodiment shown in FIG. 53. Moreover, the spiral hose can have a further improved durability by the reinforcement band 230 continuously formed on the lower surface of the concave portion 214, which has the three-layer construction of the soft polyethylene layer 232, the polyethylene tarpaulin layer 234, and the soft polyethylene layer 232 in sequence.

[0238] FIG. 55 is an enlarged partial sectional view of a spiral hose utilizing polyethylene according to another embodiment of the present invention.

[0239] In the shown spiral hose, a soft polyethylene layer 232 and a polyethylene tarpaulin layer 234 are laminated onto each other in such a way that the reinforcement band 230 has an exposed and a covered side portion which are opposite to each other in the transverse direction of the reinforcement band 230. At one side of the convex portion 212, the covered side portion of the reinforcement band 230 not only overlaps the exposed side portion of the reinforcement band 230 but also partially overlaps the covered side portion beyond the exposed side portion of the reinforcement band 230, so that the lamination attached to the lower surface of the concave portion 214 includes two layers of the covered side portions.

[0240] This construction enables the polyethylene tarpaulin layer 234 having a relatively large tensile strength to have a continuous construction without a severance, which increases the tensile strength of the reinforcement band 230, thereby improving the durability of the spiral hose.

[0241] FIG. 56 is an enlarged partial sectional view of a spiral hose utilizing polyethylene according to another embodiment of the present invention, in which the covered side portion of the reinforcement band 230 extends in its transverse direction longer than that shown in FIG. 55, that is, from the lower surface of the concave portion 214 at one side of the convex portion 212 beyond the lower surface of the concave portion 214 at the other side of the convex portion 212, so that the lamination attached to the lower

surface of the concave portion **214** includes three layers of covered side portions of the reinforcement band **230** consisting of a soft polyethylene layer **232** and a polyethylene tarpaulin layer **234**. This construction increases the cohesion between the side portions of the reinforcement band **230** to thereby highly improve the durability of the spiral hose. Further, the covered portion of the reinforcement band **230** may further extend to form a lamination attached to the lower surface of the concave portion **214**, which includes at least four layers of covered side portions of the reinforcement band **230**.

[0242] Even in the constructions shown in FIGS. **54** to **56**, soft resin such as silicon may be employed instead of the soft polyethylene layer **232**. Silicon can enable ripple portions of two spiral hoses to be easily assembled with each other, reduce frictional resistance thereby minimizing shaking of the spiral hose even when fluid is carried with a high pressure, and prevent thermal deformation of the spiral hose. In this case, it goes without saying that the constructions as shown in FIGS. **53** to **56** may be employed and may have the same effect as those and may have the same effect as those in the reinforcement band **220** shown in **FIG. 51**.

INDUSTRIAL APPLICABILITY

[0243] As can be seen from the foregoing, in a spiral hose according to the present invention, a hard member made from polyethylene has a sectional shape protruding outward with angular corners and extends in a spiral shape, and a soft member made from polyethylene tarpaulin with a small thickness is attached to the hard member while extending along a spiral gap formed between each turns of the spiral hard member. By this construction, the spiral hose has not only a sufficient resistance to internal pressure owing to the hard polyethylene member but also a high tensile strength and excellent flexibility owing to the soft member made from polyethylene tarpaulin. Therefore, in comparison with a PVC hose, a spiral hose having the same resistance to pressure can be manufactured at a lower cost and has smaller weight which enables the spiral hose to be easily carried and installed.

[0244] Further, in the case where the coated polyethylene tarpaulin layer forming the soft member has a plurality of spray holes, the spiral hose may be utilized as a watering hose. Moreover, in the case where each interval between wefts and between warps of a woven polyethylene fabric layer has a wide distance of 5 to 20 mm, the spiral hose has a further improved flexibility so that the spiral hose can be employed as a gas duct which can be bent more than 90° when the duct is installed.

[0245] Further, the spiral hose according to the present invention may include a fastening band attached along the joint portion between the hard and soft members of the spiral hose. As a result, the spiral hose not only can have a higher tensile strength and flexibility while being lighter than a PVC hose, but also side ends of the soft member need not be subjected to watertight coating, thereby increasing cohesion between the hard and soft members. Moreover, the cohesion between the hard and soft members can be increased to thereby highly increase the durability of the spiral hose.

[0246] Also, in the spiral hose utilizing polyethylene according to the present invention, a hard spiral member and a soft spiral member are assembled with each other while extending in a spiral shape, respectively, to enable the spiral hose to have a higher tensile strength, flexibility, strong resistance to internal pressure. The thick hard member has an adiabatic characteristic through its own quality of thickness, and the thin soft member has an adiabatic characteristic through being covered with a foam and an aluminum foil. Therefore, the spiral hose can insulate heat without a separate cover, thereby having an excellent heat-keeping effect. Further, the spiral hose can be easily installed and used and can maintain the heat-insulation characteristic even when it has been used for long time. In other words, the spiral hose is economical and keeps a clean appearance, thereby improving the marketability of the spiral hose.

[0247] Also, in the spiral hose utilizing polyethylene according to the present invention, which includes a hard spiral member and a soft spiral member assembled with each other while extending in a spiral shape, a reinforcement member may be disposed along a spiral groove above the soft spiral member while connecting turns of the hard spiral member with each other, so as to reinforce the strength of the soft spiral member and uniformly maintain the spiral gap between the turns of the hard spiral member. As a result, the spiral hose can be prevented from being expanded and contracted, and the durability and marketability of the spiral hose can be highly improved.

[0248] Moreover, the spiral hose according to the present invention may further include a reinforcement piece disposed across the hollow space of the hard spiral member, which prevents the hard spiral member from being deformed by external force and prevents the strength and the draining function of the spiral hose from being deteriorated due to the possible deformation of the hard spiral member.

[0249] Also, the present invention provides a watering hose utilizing polyethylene according to the present invention, in which a hard member made from polyethylene extends in a spiral shape with a spiral gap between turns of the hard member, and a soft member made from woven polyethylene fabrics is attached to the hard member while extending along the spiral gap. This construction enables the watering hose to have not only a sufficient resistance to internal pressure owing to the hard polyethylene member but also a high tensile strength and excellent flexibility owing to the soft member made from polyethylene tarpaulin. Therefore, in comparison with a PVC hose, the watering hose having the same resistance-to-pressure can be manufactured at a lower cost and has smaller weight which enables the watering hose to be easily carried and installed.

[0250] Further, the watering hose according to the present invention may include a soft polyethylene film having a band shape, which is attached along the joint portion between the hard and soft members of the spiral hose. As a result, the cohesion between the hard and soft members can be increased to thereby highly increase the durability of the watering hose.

[0251] Furthermore, the spiral hose according to the present invention may be formed of a single polyethylene member. In this case, the manufacturing process of the spiral hose can be simplified to thereby increase the productivity, and the joint portions of the single polyethylene member can have a stronger cohesion to thereby improve the durability of the spiral hose.

[0252] In addition, the spiral hose according to the present invention may include a reinforcement band for attaching adjacent concave portions to each other, thereby increasing the strength of the spiral hose, preventing deformation of the spiral hose, and highly improving the durability of the spiral hose.

[0253] While this invention has been described in connection with what are presently considered to be the most practical and preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiment and the drawings, but, on the contrary, it is intended to cover various modifications and variations within the spirit and scope of the appended claims.

1. A spiral hose utilizing polyethylene wound in a spiral shape to have flexibility, the spiral hose comprising:

a hard member made from polyethylene, which is wound in a spiral shape with a uniform spiral gap formed between turns of the hard member; and

a soft member having a shape of a band and being formed of polyethylene tarpaulin, the soft member being disposed along the spiral gap while lateral edges of the soft member are fixed to portions of the hard member, which are disposed oppositely on both sides of the spiral gap.

2. A spiral hose utilizing polyethylene according to claim 1, wherein the hard member comprises a convex section protruding upward with angular corners and flanges extending laterally from lower ends of the convex section, and the lateral edges of the soft spiral member are attached to the flanges disposed oppositely on both sides of the spiral gap.

3. A spiral hose utilizing polyethylene according to claim 2, wherein the hard spiral member assembled with the soft member is bent and protrudes outward, and the flanges are integrally connected with each other, so as to form a space inside of the hard member.

4. A spiral hose utilizing polyethylene according to claim 1, wherein the soft member comprises a woven polyethylene fabric layer and at least one polyethylene coating layer coated on the woven polyethylene fabric layer, the polyethylene coating layer having a plurality of spray holes, so that the spiral hose can be used as a watering hose.

5. A spiral hose utilizing polyethylene according to claim 1, wherein the soft member comprises a woven polyethylene fabric layer, each interval between wefts and between warps of the woven polyethylene fabric layer having a wide distance of 5 to 20 mm.

6. A spiral hose utilizing polyethylene according to one of claims 1 to 5, wherein the soft member is formed of polyethylene tarpaulin which includes a woven polyethylene fabric layer and at least one polyethylene coating layer coated on at least one surface of the woven polyethylene fabric layer.

7. A spiral hose utilizing polyethylene according to one of claims 1 to 5, wherein the soft member is formed of polyethylene tarpaulin, which includes a woven polyethylene fabric layer and low-density and high-density polyethylene coating layers coated in sequence on at least one surface of the woven polyethylene fabric layer.

8. A spiral hose utilizing polyethylene according to one of claims 1 to 5, wherein the soft member is formed of polyethylene tarpaulin, both side edges of which are fixed to outer surfaces of the flanges of the hard member, respectively.

9. A spiral hose utilizing polyethylene according to one of claims 1 to 5, wherein the soft member is formed of polyethylene tarpaulin, both side edges of which are fixed to inner surfaces of the flanges of the hard member, respectively.

10. A spiral hose utilizing polyethylene according to claim 1, wherein side ends of the polyethylene tarpaulin forming the soft spiral member are coated to form watertight ends.

11. A spiral hose utilizing polyethylene according to claim 1, the spiral hose further comprising a fastening band attached along a joint portion between the hard member and the soft member.

12. A spiral hose utilizing polyethylene according to claim 1, the spiral hose further comprising a heat-insulation foam fixed in a spiral gap formed between turns of the hard member and on the soft member.

13. A spiral hose utilizing polyethylene according to claim 12, wherein the hard member is made from high-density polyethylene, the soft member is formed of polyethylene tarpaulin, and the heat-insulation foam is formed of polyethylene foam.

14. A spiral hose utilizing polyethylene according to claim 12 or 13, the spiral hose further comprising an aluminum foil attached to an upper surface of the heat-insulation foam.

15. A spiral hose utilizing polyethylene according to claim 12 or 13, the spiral hose further comprising an aluminum foil attached to an outer surface of the spiral hose, the hard member and the heat-insulation foam forming the outer surface of the spiral hose, the aluminum foil being wound around the outer surface of the spiral hose in a spiral shape, thereby forming an outermost layer of the spiral hose.

16. A spiral hose utilizing polyethylene according to claim 12 or 13, the spiral hose further comprising aluminum foils attached in sequence to one surface of the soft member.

17. A spiral hose utilizing polyethylene according to claim 12 or 13, the spiral hose further comprising an aluminum foil attached to a lower surface of the heat-insulation foam, the aluminum foil having a shape of a band.

18. A spiral hose utilizing polyethylene according to claim 1, the spiral hose further comprising a reinforcement member made from soft material and fixed on the soft member, the reinforcement member having transverse side ends fixed to both sides of the hard member, thereby maintaining a uniform between turns of the hard member.

19. A spiral hose utilizing polyethylene according to claim 18, wherein the hard member and reinforcement member are made from polyethylene, and the soft member is made from at least one of polyethylene tarpaulin and soft polyethylene.

20. A spiral hose utilizing polyethylene according to claim 18 or 19, wherein the reinforcement member is a flexure cover which has side edges attached to adjacent side portions of an upper surface of the hard spiral member and a central portion being concave downward in a transverse sectional view of the flexure cover.

21. A spiral hose utilizing polyethylene according to claim 20, wherein the central portion of the flexure cover concave downward is fixed to an upper surface of the soft member disposed under the flexure cover.

22. A spiral hose utilizing polyethylene according to claim 18 or 19, wherein the reinforcement member is a flexure cover which has side edges and a central portion, the side

edges being fixed between side edges of the soft member and side portions of a lower surface of the hard member, the central portion being concave upward in a transverse sectional view of the flexure cover.

23. A spiral hose utilizing polyethylene according to claim 18 or 19, wherein the reinforcement member is a flexure cover which has side edges and a central portion, the side edges being fixed onto an exposed surface of the soft member, the central portion being concave upward in a transverse sectional view of the flexure cover.

24. A spiral hose utilizing polyethylene according to claim 18 or 19, wherein the reinforcement member is a flexure cover which has side edges and a central portion, the side edges being fixed to lower portions of side surfaces of the hard member, which are disposed both side of the soft member at each turn of the hard member, the central portion being concave upward in a transverse sectional view of the flexure cover.

25. A spiral hose utilizing polyethylene according to claim 18 or 19, wherein the reinforcement member is a hollow flexible member fixed in the spiral gap formed on the soft member, the hollow flexible member having outer side portions attached to adjacent outer side surfaces of the hard member.

26. A spiral hose utilizing polyethylene according to claim 25, the spiral hose further comprising a protection cover attached on the hollow flexible member, the protection cover having flexibility and forming the outer surface of the spiral hose.

27. A spiral hose utilizing polyethylene according to claim 26, wherein the protection cover is made from at least one of polyethylene tarpaulin and soft polyethylene.

28. A spiral hose utilizing polyethylene according to claim 18 or 19, wherein the hard member has a hollow sectional shape; and the reinforcement member is a flexible lamination fixed to an upper surface of the soft member and filled in a lower portion of the spiral gap between turns of the hard spiral member.

29. A spiral hose utilizing polyethylene according to claim 28, wherein the flexible lamination has a plurality of holes, each of which is formed through a central portion of each turn of the flexible lamination in a sectional view of the flexible lamination.

30. A spiral hose utilizing polyethylene according to claim 29, the spiral hose further comprising a plurality of reinforcement cores inserted in said holes formed through the central portion of each turn of the flexible lamination.

31. A spiral hose utilizing polyethylene according to claim 30, wherein the flexible lamination is made from soft polyethylene, and the reinforcement cores are made from high-density polyethylene.

32. A spiral hose utilizing polyethylene according to claim 28, the spiral hose further comprising a soft cover having a band shape, the soft cover having lateral sides attached to upper portions of the hard member at both sides of the spiral gap.

33. A spiral hose utilizing polyethylene according to claim 28, the spiral hose further comprising a reinforcement piece disposed across a center of a hollow space in the hard member.

34. A watering hose utilizing polyethylene wound in a spiral shape to have flexibility, the watering hose comprising:

a hard member made from polyethylene, which is wound in a spiral shape with a uniform spiral gap formed between turns of the hard member; and

a soft member having a shape of a band and being formed of polyethylene tarpaulin, the soft member being disposed along the spiral gap while lateral edges of the soft member are fixed to portions of the hard member, which are disposed oppositely on both sides of the spiral gap.

35. A watering hose utilizing polyethylene according to claim 34, wherein the hard member comprises a convex section protruding upward with angular corners and flanges extending laterally from lower ends of the convex section, and the lateral edges of the soft spiral member are attached to the flanges disposed oppositely on both sides of the spiral gap.

36. A watering hose utilizing polyethylene according to claim 35, wherein the hard spiral member assembled with the soft member is bent and protrudes outward, and the flanges are integrally connected with each other, so as to form a base section which defines a closed space inside of the hard member.

37. A watering hose utilizing polyethylene according to claim 34, wherein the soft member comprises a woven polyethylene fabric layer, each interval between wefts and between warps of the woven polyethylene fabric layer having a wide distance of 5 to 20 mm.

38. A watering hose utilizing polyethylene according to one of claims 34 to 37, wherein the soft member has side edges fixed to outer surfaces of the flanges of the hard member.

39. A watering hose utilizing polyethylene according to one of claims 34 to 37, wherein the soft member has side edges fixed to inner surfaces of the flanges of the hard member.

40. A watering hose utilizing polyethylene according to claim 39, the watering hose further comprising a soft polyethylene film having a band shape, the soft polyethylene film being attached to an exposed portion of a lower surface of the base section and side portions of the soft member disposed at both sides of the exposed portion.

41. A watering hose utilizing polyethylene according to claim 34, the watering hose further comprising a coated film formed on a lower portion of the inner surface of the watering hose, so as to block gaps formed through a lower portion of a woven polyethylene fabric layer of the soft member.

42. A watering hose utilizing polyethylene according to claim 34, the watering hose further comprising a coated film formed between the hard member and the soft member, so as to block gaps formed through a lower portion of a woven polyethylene fabric layer of the soft member.

43. A spiral hose utilizing polyethylene, which includes a polyethylene member having a band shape, the polyethylene member comprising a convex portion and a concave portion adjacent to each other in a transverse sectional view of the polyethylene member, the polyethylene member being wound in a spiral shape while a plurality of the convex portions and a plurality of the concave portions are alternately engaged with and fused to each other, so as to form an integral spiral hose.

44. A spiral hose utilizing polyethylene according to claim 43, wherein each of the convex portions and concave

portions has a rectangular shape in a transverse sectional view of the polyethylene member.

45. A spiral hose utilizing polyethylene according to claim 43, wherein the convex portion and the concave portion integrated with each other form a shape like a sine wave in a transverse sectional view of the polyethylene member.

46. A spiral hose utilizing polyethylene according to one of claims 43 to 45, the spiral hose further comprising a reinforcement band attached to at least two lower side ends of the concave portion disposed at either side of the convex portion so as to form a closed space inside of the convex portion.

47. A spiral hose utilizing polyethylene according to claim 46, wherein the reinforcement band is made from at least one of polyethylene tarpaulin and soft polyethylene.

48. A spiral hose utilizing polyethylene according to claim 46, wherein the reinforcement band is formed of a soft polyethylene layer and a polyethylene tarpaulin layer, the polyethylene tarpaulin layer having a width smaller than that of the soft polyethylene layer, the polyethylene tarpaulin layer being attached along a central portion of the soft polyethylene layer in a transverse view of the soft polyethylene layer so that edge portions of the soft polyethylene layer are exposed.

49. A spiral hose utilizing polyethylene according to claim 46, wherein the reinforcement band is formed of a soft polyethylene layer and a polyethylene tarpaulin layer, the polyethylene tarpaulin layer having a width smaller than that of the soft polyethylene layer, the polyethylene tarpaulin layer being attached to an upper surface of a first side portion of the soft polyethylene layer in a transverse view of the soft polyethylene layer so that a second side portion of the soft polyethylene layer are exposed, the second side portion being attached to a lower surface of the first side portion in a transverse view of the soft polyethylene layer.

50. A spiral hose utilizing polyethylene according to claim 49, wherein the second side portion is attached to the lower surface of the first side portion of the soft polyethylene layer while covering at least one adjacent concave portion, so that turns of the soft polyethylene layer overlapping on each other at each concave portion of the soft polyethylene layer form a lamination including at least two layers.

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